THE GAS JOURNAL

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A Glance at the Contents—

East Surrey Co-Partnership.

Striking figures were presented at the annual meeting of co-partners of the East Surrey Gas Company on Nov. 28, as indicating the progress of the Company's scheme. [p. 674.]

Messrs. Stewarts & Lloyds' Big Steel Project.

An event of prime importance to the whole of the British steel industry is announced in the decision of Messrs. Stewarts and Lloyds to re-start in this country the manufacture of basic Bessemer steel. [p. 701.]

Institution Research Meeting.

Fifteen pages are devoted to written contributions and authors' replies to the discussions on the reports presented at the Autumn Research Meeting of the Institution of Gas Engineers held in November last. [pp. 679-693.]

Wolverhampton Window Display.

A photograph reproduced to-day shows a display of Wright's new "Console" radiators by the Wolverhampton Gas Company. The display is part of the gas equipment for a new Church Hall in Wolverhampton. [p. 694.]

Carbonizing Plant at Lurgan.

The history and progress of the Lurgan Gas Undertaking and the results of twenty-one years of carbonizing in Glover-West verticals forms the subject of an article extracted from last month's issue of "West's Gas." [p. 675.]

Bedford Company's New Social Club.

Wednesday evening, Nov. 23, 1932, was a red-letter date in the hundred-years' career of the Bedford and District Gas Company, for it saw the fruition of a long-cherished project in the opening of their new Social Club. [p. 677.]

A Review of the Gas Industry.

The "Financial Times," in a recently published Fuel and Power Supplement, gives a very comprehensive review of the Gas Industry's activities, contributed by some of the best-known experts in the Industry to-day. [p. 674.]

Junior Association Visit Mantle Works.

On Wednesday, Nov. 30, a large party of members of the London and Southern District Junior Gas Association inspected the "Veritas" gas mantle works of Messrs. Falk, Stadelmann, & Co., Ltd., in Garratt Lane, Wandsworth. [p. 700.]

Gas Exhibition at Lincoln.

In organizing an Exhibition of Gas Appliances just at the time when we hear that the East Midland Electrical Grid is on the point of completion, the Lincoln Corporation Gas Committee have accepted the challenge in the right spirit. [p. 678.]

Economic Utilization of Fuel.

In an address to the Midland Junior Gas Association in Birmingham on Nov. 10, Prof. Burstall, dealing with this subject, said that an answer could not be given to the question, "What is the temperature of a flame?" without a statement of what was meant exactly by temperature. [p. 699.]

Social Organization Within the Gas Industry.

The present economic depression is providing industry with an opportunity to examine not only the causes, but methods by which its evil effects may be best overcome, states Mr. J. Leeming Robson, of the Birkenhead Gas Department, in an article on the Value of Social Organization within the Gas Industry. [p. 677.]

Forthcoming Engagements

Dec. 9.—LONDON AND SOUTHERN JUNIOR ASSOCIATION.—Meeting at Westminster Technical Institute. Paper by Mr. R. N. LeFevre.

Dec. 10.—YORKSHIRE JUNIOR GAS ASSOCIATION.—Meeting at Leeds University. Presidential Address of Mr. J. W. Wood.

Dec. 12.—INSTITUTION OF GAS ENGINEERS.—Meetings of Joint Research Committee, 10 a.m.; Liquor Effluents and Ammonia Sub-Committee, 12 noon; Finance Sub-Committee, 2 p.m.; Finance Committee, 2.30 p.m.; Executive Committee of the Council, 3 p.m.; Purifiers Sub-Committee, 5 p.m., 28, Grosvenor Gardens, S.W. 1.

Dec. 13.—INSTITUTION OF GAS ENGINEERS.—Meetings of Council, 10 a.m.; Education Executive Committee, 4 p.m., 28, Grosvenor Gardens, S.W. 1.

Dec. 13.—WESTERN JUNIOR ASSOCIATION.—Inspection of Gas Installation of Imperial Tobacco Company, Ltd., Bristol. Paper by Mr. E. S. Davies.

Dec. 13.—NATIONAL GAS COUNCIL.—Meeting of Central Executive Board, 28, Grosvenor Gardens, S.W. 1.

Dec. 13.—FEDERATION OF GAS EMPLOYERS.—Meeting of Central Committee, 28, Grosvenor Gardens, S.W. 1.

Dec. 14.—SCOTTISH JUNIOR ASSOCIATION (WESTERN DISTRICT).—Visit to "Glasgow Herald" Offices.

Dec. 15.—S.B.G.I.—Council Meeting, 2.30 p.m.

Dec. 17.—SCOTTISH JUNIOR ASSOCIATION (WESTERN DISTRICT).—Annual Social, Ca'doro Restaurant, Glasgow.

Dec. 21.—B.C.G.A.—Meeting of the Executive Committee, 12 noon, 28, Grosvenor Gardens, S.W. 1.

Dec. 21.—SOUTHERN ASSOCIATION OF GAS ENGINEERS AND MANAGERS (EASTERN DISTRICT).—Meeting at 28, Grosvenor Gardens, S.W. 1.

1932 "JOURNAL" Directory.

Page 50.—NORTHAMPTON. Mr. F. J. Alsop appointed Secretary vice Mr. H. A. Jacklin, deceased.

EDITORIAL NOTES

A Promising Fair

WE are not yet off with the old year, but it is time to be on with the new. At any rate, this applies to the British Industries Fair, Birmingham, which will be among the early fixtures of 1933. Everything promises to be still bigger on this occasion than before, and therefore success once again is assured. Certain arrangements have been made already, of which we have received intimation from Mr. W. L. S. Spinks, the Hon. Secretary to the Gas Industries Section, and we would ask readers to bear in mind the dates. The Joint Gas Conference will take place on Feb. 28, March 1, and March 2. Then on Feb. 23 the Joint Junior Gas Associations will pay a visit to the Fair, and this will be followed on the next day, Feb. 24, by a visit of the Gas Salesmen's Circles. For the 1933 Fair the area of the Gas Industries Section is to be considerably increased, over 1600 sq. ft. of extra stand space having been added, and the whole of the available space in the Section has now been allotted—a remark which applies also to other portions of the Fair.

Another matter to which attention should be drawn is the hotel accommodation. In that connection demands are greater this time than ever before, and visitors who are staying in Birmingham for one or more nights during the period of the Fair should immediately get in touch with the Accommodation Department, Birmingham Chamber of Commerce, 95, New Street, Birmingham. Here a systematic record is kept of all rooms available in hotels and boarding houses in the city, as well as in those towns within easy reach. Applicants should state whether they require accommodation in hotels, private hotels, or boarding establishments; whether they are willing to go outside the city; and, if so, whether they prefer to travel to the Fair by road or by rail.

Worth-While Letters on World-Wide Problems

How deeply the opinions of Sir Arthur Duckham were valued in the Gas Industry and in the Iron and Steel Trades—sections of the Nation's activities in which his leadership proved so beneficial—there is no need here to stress. In this respect the great loss occasioned by his death is still felt, as it is also from the personal point of view. He was both a sound leader and a staunch friend. Both good leaders and real friends are scarce (which are the more so will be determined by individual experience). We certainly cannot have too many or too much of either, and it is therefore with especial pleasure that we take this opportunity of thanking Lady Duckham for having published to the world the letters which Sir Arthur wrote to her on his voyage across the Atlantic during the winter of last year.

To take this little volume to an armchair by the fireside, or to read it on a railway journey is to feel—at any rate, that was the experience of the writer of this note—that one is again in the company of the author. The letters are written in the breezy, straightforward manner in which Sir Arthur Duckham was in the habit of speaking; indeed, they possess one of the greatest of literary charms, in that the language in which they are presented is precisely the same as he would have used in talking. Those who knew him must have this book, and they will treasure it; those who did not know him personally have now a chance of becoming acquainted with the man through his letters. So that nothing should stand in the way, the volume has been published at the modest price of 5s. net by Messrs. Eyre & Spottiswoode, Publishers, London.

The letters were written home during a lonely trip across the Atlantic at the latter end of 1931—lonely as he had none of his dear ones with him nor a congenial companion, though not lonely inasmuch as the ship held happy memories of past voyages and he was surrounded by friends of the ship's company. "You and I," says Sir Arthur Duckham to his wife, "like all other human beings, feel the effect of all these great world upheavals and misfortunes; we discuss them and endeavour to understand them in order to see how we can help to fight back these menaces to our well being and happiness. . . . I have been fortunate in experience, having carried my full share of national and industrial responsibilities, having travelled in many countries, and having had reason to investigate their politics, industry, and daily life. Yet my knowledge is very small when compared with the scope of the question, and my opinions are only half formed. I cannot feel sure that the greater part of my premises are sound. Now, here is the opportunity to think things out and set conclusions down. Ten days free from the pressure of business, free from the distractions of holiday. Ten days in which I can talk to you."

The Views of a Leader

ACCORDING to Sir Arthur, we lack three things—goodwill, understanding, and courage. It is no doubt true, as stated by him, that "the world has got into this sad mess because goodwill has been lacking between individuals and between peoples, because understanding is greatly lacking, and because we had not the courage to do that which we felt to be right and necessary." The part of the volume which deals with the financial position throughout the world is of outstanding value, inasmuch as subjects of extreme complication are presented in language so simple as to be readily understood even by those who can lay no claim to expert knowledge. Then we come to other matters which afford much material for reflection: The ship crawls its way up to Quarantine, and eventually docks. "How much money we waste, and how much discomfort we cause ourselves, by all these formalities of getting into each other's countries! Thousands of people are employed in a non-productive job, and thousands of people are held up who might be getting on with something else. Haven't you often noticed the difference in the amount of work people do and the value of their work? Go to a factory and see men and women working on a highly organized productive job; every minute of their time is usefully employed. On the other hand, take a doorkeeper to an apartment house; about three times an hour he opens the door of a taxi. Take a porter on a little wayside station with about six trains a day! Compare the intensity of work of a platelayer on the railway with that of the man looking after the steel in a big rolling mill. The wages are in no way comparable to the effort each makes, nor to the services each renders for the benefit of the country."

Again: "I have made many trips to America. I like and admire the country and the people, and am in sympathy with their aims and aspirations. Each visit broadens my viewpoint; we foreigners who visit a country often form a better all-round opinion of the situation, and can sum up facts and their effects better than can the people of the country themselves." Starting out to indicate, on the return journey, some of the impressions received during his visit, the author gives a vivid account of the slump in the American stock market, and we have his declaration: "I am not a Communist. I am all for the proper reward of individual effort, but I believe a time will come when our present financial system will have to be changed." And further on: "The vote of democracy is too readily bought by the promises of politicians; and, in the world's history, democracy has failed because those in power have not been able to find the money to pay for the promises which they made before election."

The belief is expressed that the greatest development of wealth production in Great Britain can come from

the agricultural industry, and then, after a dinner which went off very well: "How often in life people fill themselves with pleasure until they reach satiety! Always leave off while the going is good, and the desire for more still remains. Often we regret leaving some wonderful place; but if we stayed another week, the glamour might be lost, and our memories, the dearest of all human possessions, would be spoiled. We seek some friends' society; how pleasant when we leave them to look forward eagerly to the next meeting! We enjoy a meal; but too much has been given to us. We feel replete. Our enjoyment is lost."

Here we put aside the volume—grateful for this happy chance of mingling once again our thoughts with those of the writer of the letters, and grateful, too, for the memories which, with Sir Arthur, we hold to be the dearest of all human possessions.

Modern Gas-Making Practice

SINCE the passing of the Gas Regulation Act in 1920 we have gone a long way towards supplying a gas of constant quality. Uniformity of calorific value is to-day assured, but it may be questioned whether quite sufficient attention is even now paid to the other properties which concern uniformity of supply—specific gravity and composition. This point is made by Mr. B. Richardson in a paper before the Auxiliary Section of the North of England Gas Managers' Association. He gives a highly interesting table setting out the analyses of six samples of town gas, all of the same calorific value (500 B.Th.U.), but each produced in a different way. The figures show that, while supplying a gas which, judged by the calorimeter, is of constant quality, it is possible to have at the same time variations of over 10% in the air requirements for combustion and nearly 20% in the specific gravity by altering the method of manufacture. The fact is brought out strikingly that the least satisfactory type of gas is that obtained by diluting straight coal gas with waste gas—in other words, by "over-pulling." It is unsatisfactory not only because of its high specific gravity due to the large percentage of inert constituents, but also because of its lower flame temperature.

This matter of constant composition has an important bearing on the problem of giving the country gas of a standard quality, with the advantage of standard appliances. There is a trend towards this at present, due to amalgamations, but it is difficult to envisage a standard gas in present circumstances or with the conditions likely to obtain in the near future. On the other hand, most of the gas sold to-day falls within a narrow range of calorific value, and efforts should be made to do away with the gas and air adjuster on apparatus of all kinds. If, for example, we had a series of either three or four gas-air ratios (*i.e.*, fixed air ports and a definite size of gas injector), the result would be a general tightening-up of the gas manufacturing process which would be of benefit to all concerned. Greater uniformity should be the aim; and we agree with Mr. Richardson that it is difficult in certain instances to appreciate why adjacent gas undertakings equidistant from the coalfields and apparently supplying similar areas should make gas of widely different heating value per cubic foot.

The title of Mr. Richardson's paper is not a good one. "Modern Gas Practice" means much more than the manufacture of gas, on which phase of the Industry's activities the author concentrates. This may seem a trifling criticism, but to our mind it indicates the mistaken conception that gas making is gas practice, and it explains why progress was retarded in the past. On gas-making practice, however, the author's broad survey is full of useful information and suggestion. Among other things, he shows the different results obtained by working water gas plant continuously and intermittently, and maintains that in those works diluting straight coal gas with water gas it would be cheaper to operate a small unit continuously than a larger plant one shift per twenty-four hours. The extra labour costs would be recouped by the increased yield of better quality gas per ton of coke used in the generator. Another interesting matter discussed by Mr. Richardson is the influence of hydrocyanic acid on the corrosion of mains and services. He thinks that its influence as an active agent of corrosion has been very much over-estimated. As a result of a number of tests conducted all over his district of supply, it was found that the hydrocyanic acid content of the gas was remarkably constant and practically the same as that leaving the works, showing that little absorption of this compound takes place. Again, voluminous masses of rust recovered from old services have frequently been found to contain a mere trace of prussian blue. In regard to the determination of hydrocyanic acid in gas, our readers will be interested in the author's outline of a simplified method he has successfully introduced.

Finally, Mr. Richardson's comments on the coke market are well worth underlining. There is no doubt that the public tend to condemn coke not because it is more difficult to ignite than coal, or because it burns without much "flickering flame," but because of its moisture and ash contents. Cleaner coals, efficient blending, more careful quenching, better screening, greater service after sales—these provide the solution to the coke problem. "It is imperative," says Mr. Richardson, "that the public should be offered a coke low in ash, dry, and of uniform size; and there is no excuse for saying we do not know how to make such a grade, for a great deal of information is available to the Industry concerning the properties of coke required for the various uses." To which we would add: Ensure that deliveries are uniform.

A Satisfying Career

THERE never was a time when the ambitious youth entering the Gas Industry was more assured of sympathetic encouragement by his Seniors, though admittedly we have a long way to travel before the rates of remuneration offered universally become commensurate with the qualifications expected. However, the Gas Industry has good reason to be gratified with the type of young man it is in general recruiting at the present time.

It is a sign of the times that both the President and a Past-President of the Institution of Gas Engineers should have addressed Junior Associations during the past few weeks. Mr. Gibson visited Bristol to talk to the Western Juniors, while Mr. Copp addressed the Yorkshire Juniors in Leeds. Both occasions exemplify the real desire on the part of the Institution to offer practical assistance to the younger members of our Industry, and both addresses will, we hope and believe, receive the careful reading which their worth merits.

We are extremely glad that Mr. Copp refers to the desirability of recruiting physicists, because we have felt for long that many of the problems of gas manufacture, distribution, and utilization can be solved only by the physicist. We are sure that physical research, as well as purely chemical investigation, is necessary to the Industry's progress. Another point in Mr. Copp's address which appeals to us strongly is his insistence that salesmen in our Industry should have a working knowledge of, as distinct from mere acquaintance with, the progress of competing interests, their sales methods, and the appliances which they offer. This implies a reasonable amount of technical training—not specialization as now understood, but sufficient knowledge to enable the salesman readily to grasp the principles underlying competitors' developments.

The need for technical training is emphasized also by Mr. Gibson, who speaks particularly of the industrial salesman. For industrial work, efficient salesmen can only be found among those who are capable of discussing intelligently with the manufacturer the problems which he has to face, and it is a fact that the industrialist of to-day is usually well able to appreciate technical niceties concerning his processes, and to form a pretty true estimate of the capabilities of salesmen—whether they be selling gas, oil, or electricity—to assist him. It is a fact, too, that there is a dearth of suitable men for employment as industrial gas salesmen. The uses of gas in industrial processes is a field of technical work

to which any keen engineering enthusiast could apply himself in the confidence that the time spent on its study would be well rewarded. Mr. Gibson cites a factory which used producer gas for heating purposes. The advantages of town gas were effectually put before the proprietors, with the result that the producer gas plant was scrapped. That was some years ago, since when the consumption of town gas in that one factory has grown enormously and is now equivalent to the consumption of a small town. This is just an example of what lies before the Gas Industry if it tackles industrial work in the right way.

Part of Mr. Gibson's address is concerned with new uses for gas, such as its application to motor transport and its delivery in bottles for other purposes, and with possible improvements in appliances. Among the problems which, he suggests, offer scope for investigation, however, are two which appear to us to be quite beyond the wit of man. One is the production of a gas meter which will " measure " actual therms instead of cubic feet, and the other is a portable gas fire " which will not emit products of combustion." Another problem, " a gas fire which will automatically maintain a uniform temperature in a room," is already solved. A thermostatic device could easily accomplish this feat, were it desirable. However, the fact remains that the Gas Industry is capable of offering to scientific youth a thoroughly interesting and satisfying career.

Correspondence

The Applicant's Viewpoint

SIR,—In connection with the article in the " JOURNAL " of the 23rd inst., may I suggest that the stipulation in most advertisements that copies of three recent testimonials must be forwarded with the application makes many well qualified men hesitate to apply for a position, as they are diffident to approach their employer for a testimonial, feeling that it may prejudice their position.

No doubt most employers would be only too anxious to assist their employees to obtain promotion; but in some cases, not wishing to lose the services of a good man, there may be a great inducement to damn his application with faint praise and vice versâ, to give a favourable testimonial to an employee they are not anxious to keep. In my Army experience I have seen many cases of good men —specialists at their job—who have been passed over for promotion as the C.O. did not want to lose them, and other men recommended for promotion who were not qualified for it.

In my opinion, it would save the applicant and the advertiser time and trouble if, in the first place, applications only were asked for and a selection of suitable candidates made from these. Selected candidates could then be requested to submit testimonials.

" INDUNA."

Nov. 26, 1932.

Continuous Meter Reading and Billing for Quarterly Consumers

SIR,—I was pleased to see a reference to this subject in the leading article of your issue of Nov. 30 under the heading of " Mechanized Offices," p. 605.

My Directors have had this system under consideration for some time, by which the meters would be read and the accounts sent out once a quarter—and approximately at the same date in each quarter—but not, necessarily, near to each quarter day as at present.

The advantages of such a system, so far as meter reading and office records are concerned, are very apparent, but we should like to ascertain from your readers who have the system of continuous meter reading and billing in operation what are the difficulties (if any) encountered with the consumers during the first months of its inauguration. Is the relationship between the undertaking and its consumers improved by the introduction of such a system? Does it enhance goodwill? It seems to us that herein lies the crux of the whole question of continuous meter reading and billing.

Yours, &c.,
T. CARMICHAEL,
General Manager.

Portsmouth Gas Company,
The Square, Portsmouth,
Dec. 5, 1932.

PERSONAL

Mr. F. J. ALSOP has been appointed Secretary to the Northampton Gaslight Company in succession to the late Mr. H. A. Jacklin.

The Gas Salesman's Pocket Book, 1933

Encouraged by the wonderful reception which the Industry has given to recent issues of this annual, the author and the publishers have put every possible effort into a thorough revision of the text from beginning to end. They have extended the scope with the definite object of providing the Gas Industry with just those facts and figures which are liable to be required at any hour of every day, but which are unobtainable elsewhere in concise reference form. One of the main problems has been to accommodate all the information which is considered useful without increasing the bulk of the book beyond the comfortable pocket dimensions which have proved so popular. But this has been achieved without the omission of anything which cannot well be dispensed with, and a closer sectionalizing of the text has the effect of rendering reference even more easy than heretofore.

Among new features which will meet with unqualified approval in their respective spheres, we might mention two as examples. Particulars of all gas-using appliances are given in much more detail and are greatly extended to cover practically every piece of apparatus in the Industry. *Capacities, dimensions,* &c., appear this year *in addition to consumptions.* For the student, for whom the Pocket Book is generally recognized as an indispensable text book, an entirely new Section reproduces the questions set in the 1932 Examinations of the Institution of Gas Engineers and the City and Guilds of London Institute. There are actually fifty additional pages of invaluable information in the new edition.

One of the great needs of to-day is the active co-operation of architects and builders, and gas undertakings which present a copy to those in their area will find that it is greatly appreciated. This is proved by experience, and it is an ideal opportunity of counteracting in a practical manner the quantities of literature which competing interests place in their hands.

In a few days the dispatch will begin of the large numbers of the 1933 Edition which are already booked for delivery to gas undertakings of all sizes. Those who have delayed ordering will be wise to do so at once, so as to avoid the inevitable year end rush, and place as soon as possible in the hands of their salesmen and fitters this up-to-the-minute information on all their problems. The price of the book is 3s. 6d. post free from the " GAS JOURNAL," 11, Bolt Court, Fleet Street, E.C. 4, while the discount offer, which has proved so popular, of two dozen copies and over at 2s. 9d. each is repeated this year.

BOOK REVIEWS

GAS AND WATER ENGINEERS' CALENDAR, 1933.*

The new edition of this useful calendar appears with commendable promptness which enables all who intend purchasing it to obtain a copy in good time for the new year.

Apart from the usual revision of the particulars of the output and personnel of the gas-works in most European countries, but few alterations have been made, though, naturally, summarized information is given of new legislation affecting the German Gas Industry. A welcome new feature does, however, appear—namely, a list of the official titles and addresses of the institutions of gas engineers of the various countries.

The calendar is so well known that there is little need for anything but a mere reminder that the time has now come for those who find it indispensable to replace the old edition by the new one.

* " Kalendar für Das Gas- und Wasserfach," 56th Edition, 1933. Munich and Berlin : R. Oldenbourg. Part I., pp. 387. Price, RM. 5 bound.

THE NEWS OF THE WEEK

The Johnstone (Renfrewshire) Gas Committee have reduced the price of gas in the village of Howwood by 7½d. per 1000 c.ft.

Belfast Gas Supply is being extended to Carnmoney village and district, necessitating an extension of main for one mile at an estimated cost of £1400. The price of gas for the areas is fixed at 4s. 9½d. per 1000 c.ft. through ordinary meters, less 20 p.ct. discount within one month, or 3s. 10d. per 1000 c.ft. net.

At a Blackburn Trade Gathering, on Dec. 1, the Town Clerk referred to the steps taken by Messrs. Moffatt, manufacturers of gas cookers and other appliances, of Weston, Canada, in acquiring part of a large modern mill in Blackburn as their British depôt, and said if everything proved satisfactory the firm might enlarge and export goods as well as supply the home market.

Yorkshire Junior Association.—The next meeting of the Association will be held on Saturday, Dec. 10, in the Lecture Room of the Fuel Department, Leeds University. The President of the Association, Mr. J. W. Wood, M.Sc., will deliver his Presidential Address. Prof. J. W. Cobb, C.B.E., B.Sc., F.I.C., has kindly granted permission for members to inspect the laboratories and equipment in the Fuel Department prior to the meeting, and members who wish to avail themselves of this opportunity may do so after 2 p.m.

Hospitals and Electric Light.—Parts of Ilford, Seven Kings, Goodmayes, and Chadwell Heath were affected by a breakdown in the electricity supply on the night of Dec. 1. All the tramcars were brought to a standstill; the London-Southend main road was in darkness for miles; and the Ilford Isolation Hospital had to resort to candles. At King George's Hospital and the Maternity Hospital, Ilford, standby gas lighting was fortunately available. The breakdown was stated to be due to the failure of a cable, and the trouble was remedied after about an hour.

A Novel Scheme has been instituted by the Cheltenham and District Gas Company in the form of business reply cards which are delivered to all consumers by the meter inspectors or coin collectors. On these cards there is a list of gas appliances—fires, cookers, geysers, water heaters, irons, radiators, lighting—and the consumers are invited to mark with a cross the items upon which information is required, stating the day and time when the Company's representative may call. Up to the present the scheme has met with considerable success, and not only renders it a simple matter for consumers to apply for advice, but also has the effect of keeping before them the names of the gas appliances.

According to a Report in the "Times," Members of Parliament once more had their attention drawn to electricity on Dec. 4, when, immediately after the rising of the House of Commons, and while members were dispersing, the wires of one of two swinging lights which were being lowered fused, and there was an outburst of flame near the roof of the Chamber. The bulb fell on to one of the seats on the floor of the House and burst. Members hurried back into the Chamber and watched the burning wires, as there appeared to be some danger of the wooden roof catching fire. Workmen climbed on to the roof, and, opening one of the wooden panels near the light, were able to reach down and remove the burning cable.

A Highly Successful Gas Exhibition has just been concluded at Hebden Bridge under the auspices of the Hebden Bridge and Mytholmroyd Gas Board. The firms exhibiting were the Richmond Gas Stove Company and R. & A. Main, Ltd., for cookers and fires, and Messrs. Dean & Co. and Bray & Co. for boilers, &c., and lighting burners respectively. Miss Tuxford was the Cookery Demonstrator, drawing large audiences to her lectures, the result being that during the second week the Exhibition had to be transferred to a larger hall. Messrs. Dean & Co. also demonstrated gas washers very successfully. In conjunction with the Exhibition the War Memorial at Mytholmroyd and St. John's Church, Hebden Bridge, were floodlighted.

At an Exhibition of Ulster Products held by the Ulster Industries Development Association in Bangor the local Gas Department arranged, in conjunction with Messrs. Radiation, Ltd., a good display of modern gas apparatus. The exhibition was a great success from every point of view. Good business was done by the Department, and many inquiries subsequently resulted in sales.

Penrith's New Gasholder, erected by Messrs. R. & J. Dempster, Ltd., with a capacity of 270,000 c.ft., was officially opened on Dec. 1 by the Chairman of the Urban Council (Mr. Fred Stephenson) at a pleasant little gathering of members and officials at the Works. Mr. John E. Newton, Chairman of the Gas Committee, congratulated the contractors and the local Manager and Engineer (Mr. J. Corrigan) on carrying out a work which was much appreciated. Mr. Newton, who was presented with a silver cigarette case, suitably inscribed, said the output in 1892 was 32 million c.ft.; to-day it was 87 millions. During the last two years their works had been practically re-constructed and rebuilt through the enterprise of the Committee and the Manager. The total cost was about £15,000, but everyone agreed that the money had been well spent.

More Buyers than Ever.

The Department of Overseas Trade announces that already, some three months before the opening date, the number of overseas buyers who have signified their intention to visit the British Industries Fair at Olympia and the White City, London, and Castle Bromwich, Birmingham, next February, is more than 30% larger than the corresponding number last year, when the attendance of buyers set up a record.

The Department sends out special invitations to some 67,000 buyers in about a hundred different overseas countries and territories. Replies this year have been prompter than ever, and especially marked interest is shown by letters received from buyers in Holland, Germany, Denmark, Belgium, and France. Most of the Scandinavian countries will be well represented.

The Fair, which will be held from February 20 to March 3, will be larger and more varied than any of its predecessors. The area booked by exhibitors at Olympia and the White City is 21% larger than that occupied at the last Fair, and additional buildings to accommodate more exhibits have been made necessary at Birmingham.

Among the exhibits at Olympia will be the Gas Light and Coke Company, the South Metropolitan Gas Company, Imperial Chemical Industries, Ltd., and the Society of Chemical Industries.

Pulling Power of Press Publicity.

"I believe the Press to be the most powerful publicity agency in the country," declared Mr. E. Stanley Leatherby, a well-known public man and a principal of one of the largest and most enterprising business firms in Plymouth, in the course of a business talk to young men of the city. He went on to say that his qualification for dealing with the subject was that his firm spent a considerable sum annually on such publicity, which had been so satisfactory as to justify an increasing amount being devoted to it every year.

"Any success that has attended our efforts," he added, "is the result of advertising space we have so consistently utilized for nearly a quarter of a century in our local newspapers. I emphasize *consistently*, because, while some believe in a big appeal being inserted intermittently, we have rarely, if ever, missed a day when our name and merchandise have not been displayed in some corner of the Press. While experts may differ as to the best means of catching the eye of the public, it is pretty generally acknowledged to-day that it pays to advertise, and there are few progressive firms who have not recognized this. The wise trader has long since taken the utmost advantage of this great truth, and the professions are no longer blind to its advantages."

THE NEWS—continued.

Sixth List of Bookings for Film "Tar."

Provisional bookings for the film "Tar," subject to local variations and contingencies, have been made for three days showing at each of the following theatres:

Dec. 15.—Lyric, Lymington.
,, ,, Savoy, Hayling Island.
,, 19.—Cinema, Snodland.
,, ,, Woodhouse Street, Leeds.
,, 22.—Victory Palace, Parkstone.
,, 26.—Victory, Milford-on-Sea.
Jan. 2.—Garrison, Blackdown.
,, 5.—Cinema, Ware.
,, ,, Criterion, Gosport.
,, 9.—Roxy, Hamilton.

Meter Testing Apparatus.

[*Courtesy of the "Midland Daily Telegraph."*

Mr. Poole, Works Manager of Messrs. George Wilson Gas Meters, Ltd., demonstrating to members of the Midland Junior Gas Association part of the special apparatus for testing gas meters for the register of by-pass consumption—a test which every meter must pass before leaving the works.

East Surrey Gas Company.

Growth of Co-Partnership.

Striking figures were presented at the annual general meeting of Co-partners of the East Surrey Gas Company, held at the small Market Hall, Redhill, on Monday, Nov. 28. A pleasing feature of the proceedings was the presentation of awards to employees who had been successful in passing with credit examinations under the ægis of the Institute of Builders, the Institution of Gas Engineers, the City and Guilds of London Institute, the British Commercial Gas Association, and the Royal Society of Arts and Commerce, London. Mr. G. R. Hunt, J.P. (Chairman of the Committee), presided, and there were also present Messrs. W. Lees Stenning, J.P. (Chairman of the Company), W. H. Bennett (Managing Director), R. H. Mew and J. Urquhart (Directors), Horace Long (Hon. Secretary to the Committee and Secretary to the Company), Ernest Scears (Chief Engineer), Arthur Tennant (Sales Manager), and co-partners from Redhill, Reigate, Godstone, Lingfield, Walton-on-the-Hill, and Dorking.

The Committee, in their nineteenth annual report, stated that the Co-partnership Scheme had developed to quite remarkable proportions, and the members throughout the Company's widespread area indicated in many ways their keen and increasing interest. Investment in the stock of the Company during recent months had been particularly profitable. The low price at which, under the Scheme, the "B" ordinary stock had been available to co-partners showed a most favourable margin. The bonus and interest for the past year amounted to £2098, and the deposits on savings' account reached a total of £931. Co-partners had invested in the Company's capital stock during the year the sum of £2205, and the stock held under the Scheme up to June 30 last amounted to £12,890, an advance of £1390. Transfers of stock after that date had brought the total up to £14,845, divided among 224 co-partners.

The Chairman, having extended a hearty welcome to the co-partners, expressed the hope that they would all thoroughly enjoy the entertainment which would follow that meeting. Mr. Hunt said the number of co-partners now on the register (233) was practically twice the number they had as recently as ten years ago. The bonus and interest distribution was at that time £960, whereas the amount had now grown to the very considerable sum of £2098. The capital stock held by the co-partners ten years ago was £1450. This figure had strikingly increased to nearly nine times that amount—namely, £12,890. The price of this stock on public transactions now was about £120 per £100 stock.

Success of Leamington Cookery Demonstrations.

At the recent demonstrations at the Leamington Gas Showrooms it was emphasized that the object was to point out the most economical methods of using a gas cooker rather than to introduce new recipes, &c., and some very economical results were obtained.

For example, a complete meal comprising: 3½ lbs. loin of lamb, 1½ lbs. baked potatoes, 1½ lbs. stewed onions, and a large treacle tart, was cooked in one of the new Flavel cookers with thermostatic control in 52 minutes with a consumption of 19 c.ft. of gas, which at the current price of 3s. 4d. per 1000 c.ft. represents well under one penny.

The demonstrations have been followed up this week by calls at the homes of housewives who took advantage of the invitation, mentioned in these columns last week, to ask Mrs. Roberts, C.D.S., to advise them on any point in connection with their gas cooking operations about which they were in doubt.

A Review of the Gas Industry.

The Fuel and Power Supplement of the "Financial Times," published on Dec. 5, includes a very comprehensive review of the progress and activities of the gas and allied industries by some of the most prominent experts of the day.

In a Foreword, Mr. P. C. Pope, Secretary of the Institute of Fuel, states that fuel, being the principal source of power, controlled heat, and artificial light, is, directly or indirectly, absolutely essential to every industry. Coal, the raw fuel with which nature has so richly endowed this country, has, until recent years, been so plentiful and cheap that comparatively little attention has been devoted to its economical use or its conversion from a crude material into a more refined product or other commodities which would be of increased value for many industrial processes.

Dealing with coal conservation, Dr. F. S. Sinnatt, M.B.E., Director of Fuel Research, emphasizes the elimination of wasteful usages, and refers to the use of suitable coals, the carbonization industries, domestic heating, and substitutes for oil, including the so-called "colloidal fuel." Mr. A. H. Lymn, M.I.Chem.E., M.Inst.F., and Mr. L. H. Sensicle, B.Sc., F.I.C., in two interesting contributions, review, first, the past and present conditions of the British coking industry, with particular attention to the utilization of surplus gas and the gas grid schemes; and, secondly, the remarkable achievements in the progress of gas manufacture during the last two years, indicating the striking advance in gas production, with its consequent valuable contribution to the cause of smoke abatement, details of the advent and growth in popularity of the C.O.L. intermittent vertical chamber oven, with particulars of the coke quality and the economics of the question. They mention specifically, among others, the installation of 66 C.O.L. type vertical chambers, having a capacity of 6½ million c.ft. per day at the Wandsworth Gas-Works, and the similar plant at the Brentford Works of the Gas Light and Coke Company, the output in this instance being 10 million c.ft. per day; while reference is also made to two further installations of this type in the London area, completed by the Woodall-Duckham Company—namely, the 9-million c.ft. per day plant at Southall Works of the Gas Light and Coke Company and the 7-million installation at Croydon.

A section by Mr. C. P. Finn, M.Sc., F.I.C., M.I.Chem.E., F.Inst.F., of the Coke Oven Department of the Manvers Main Colliery, is devoted to developments at home and abroad of the bye-product coking industry, with reference

to the price-cutting problem. In regard to the Gas Light and Coke Company's Koppers coke oven installation, the author remarks that it would appear that this plant, as a gas-making unit, will take the base load of the Company at Beckton, and the production will be augmented as and when required by gas manufactured by the orthodox methods adopted by the Gas Industry of this country. Reference is also made to the important question of pit-head installations.

DERIVATIVES OF COAL.

Under this heading, Mr. H. Hollings, Chief Chemist of the Gas Light and Coke Company, draws attention to marketable products and their importance, and gives an interesting table of statistics showing the materials used and the products obtained by authorized gas undertakings in Great Britain during the past four years. The various products derived from coal tar, says Mr. Hollings, have often been detailed, and it is proposed to deal here only with one or two features of the present position which may be of economic importance. He mentions two of the new benzole recovery plants recently installed in the London area, one of which has a daily capacity of 20,000 gallons of crude benzole, and he emphasizes that the present high prices of motor spirit continue to stimulate interest in the process of hydrogenation.

Pulverized and "colloidal" fuel are also dealt with by Commander H. D. Tollemache, who cites the Cunard Company's fuel experiments, and sets forth the advantages and disadvantages of powder and liquid fuel; while Col. W. A. Bristow, Chairman of Low Temperature Carbonisation, Ltd., enlarges upon the subject of smokeless fuel from coal, and oil production at the Barugh Works. Mr. Kenneth Gordon, of the Coal Hydrogenation Department of Imperial Chemical Industries, further deals with the hydrogenation process and the production of oil from coal and tar.

The efficiency of gas as a fuel forms the subject of an interesting contribution by Mr. Stephen Lacey, B.Sc., M.Inst.C.E., Controller of Gas Sales of the Gas Light and Coke Company, who refers to the recent developments and present-day efficiency of gas appliances, together with the great service that the Gas Industry is rendering to industry in providing a reliable source of fuel supply.

Sir Francis Goodenough, C.B.E., approaches the subject from the viewpoint of the Gas Industry and Health, and the triumph of facts over fears. He draws attention to the modern gas fire, with its low fuel cost and high radiant activity, one of the most economical of the convenient sources of radiant heat, and its inestimable value in overcoming the "curse of smoke."

Other contributions to this valuable supplement include the subjects of "The Gas Industry and Competition," and "Gas as a Fuel for Vehicles," in which the marked economy in running costs is emphasized, and details of the various local experiments in different parts of the country are given.

As a whole, this Supplement forms a very fine piece of propaganda for the Industry, and will well repay study by all who have the interests and advancement of the Industry at heart.

Furthering Gas Progress in : : Northern Ireland : :

Twenty-One Years of Glover-West Verticals at Lurgan

[From "West's Gas"]

Gas was first introduced into Lurgan in 1848, by a company under the title of the Lurgan Gas Light and Chemical Company, whose works were purchased in 1915 by the Lurgan Urban District Council for the sum of £42,000. Four years prior to this change-over, the Company put in an installation of Glover-West vertical retorts, and thus Lurgan became the first town in Ireland to adopt the new form of carbonizing plant. Gas-making in this unit began in August, 1911.

The installation was designed for a daily gas-making capacity of 250,000 c.ft. of gas, produced in a setting of eight retorts, each 30 in. by 12 in. in cross-section and 23 ft. long, arranged two retorts in line but worked in separate units of one retort. Thus each retort was individually heated by eight combustion chambers and two circulating chambers, with cast-iron chambers at the base around which the secondary air circulated. Originally, the retorts were built of fireclay moulded sections, but they were re-set in 1923 with silica segmental blocks making up the retort proper, fireclay blocks in the top circulating chambers and firebrick displacing the cast-iron bases. The method of heating remained as before. Two producers serve the setting, each supplying fuel-gas for four retorts. The plant has continued to supply all Lurgan's gas up to the present time.

The retort house is of the usual steel-framed brick-panelled design, the building and the retort bench resting on mass concrete foundations.

Coal is supplied to the overhead coal bunkers by a steam-driven lift, which also elevates coke for the producer and retort feeds. Coal is fed to the plant either direct from a receiving hopper or through a coal breaker, the mouths of each being at ground level. Coke discharged from the mouthpieces is wheeled by barrow direct to yard.

All machinery—*i.e.*, the extractor driving gear and the lift drive, is actuated by two West's vertical steam engines in duplicate. Steam was supplied by works boilers until the summer of 1930, when a Spencer-Bonecourt natural-draught, surplus-heat boiler was introduced. This boiler is designed to raise 1120 lbs. of steam per hour at a pressure of 100 lbs. per sq. in. superheated 50° F., and it was estimated that this would allow for an output slightly exceeding that of the original works boilers, thereby effecting a considerable saving on fuel and labour costs.

BEFORE STEAMING.

The original vertical retort plant was installed before the introduction and development of the "steaming" process. The coal then carbonized was "Hardwick," which gave an average yield of 65 therms per ton. To-day, carbonizing a much inferior Scotch coal, the yield obtained is 76 therms, and the cost of manufacture is very low, in spite of the fact that coal costs 31s. per ton and handling is expensive. It is to be noted that gas is still made in retorts of the original non-steaming type as installed in 1911. Actual working costs per 1000 c.ft. are:

	Pence per 1000 C.Ft.
Coal (*less* residuals)	11·52
Purification	0·23
Salaries	0·91
Wages	4·18
Maintenance	0·12
Total	16·96

This was the figure realized for the year ended March 31, 1932. During this year 3452 tons of coal were carbonized and the total make was 72,182,000 c.ft.

One of the outstanding features of the carbonizing plant is its low maintenance cost. Since its inauguration the total quantity of gas produced is 1191 million c.ft. The total expenditure on the plant, including one new foul main and once re-setting, is £3000, representing 0·6d. per 1000 c.ft. of gas produced, or £142 per annum.

In 1911, when the verticals were introduced, the Lurgan undertaking had an annual make of 42 millions, and served 1350 consumers, 650 of whom were supplied through ordinary meters and 700 through slot meters. The Company's distribution system at that time comprised 12 miles of mains. The figures at the present time are:

Annual make	78 million c.ft.
Total consumers	3400 (600 ordinary meters, 2800 slot meters)
Total miles of mains	17

Electricity was introduced into Lurgan five years ago, when the annual gas output was 68 million c.ft., so that

in the face of electrical competition, over a period of five years, an increase of 10 millions in annual make of gas has been realized. It is also interesting to record that upon the introduction of electricity, the Gas Undertaking lost the public lighting contract for all the centre portion of the town; but early this year the Department was instructed to convert all electric street lamps to gas, and thus Lurgan, after a prolonged trial period with electricity, has become an entirely gas-lighted town.

Sales Progress.

On the sales side the Undertaking has made remarkable progress. At the present time extensive new offices and showrooms are in course of erection, a step rendered necessary by the greatly increased volume of business in the sales of gas appliances, which last year reached a wonderful record, exceeding previous sales by as much as 100%.

The price of gas in Lurgan is 4s. 6d. per 1000 c.ft., but under a new tariff brought into operation last year, gas is supplied for specified purposes—water heating, fires, and caterers' cooking appliances (including fish-frying ranges) —at a special charge of 2s. 6d. per 1000. This system has been proved a great success. As a direct result of it, some consumers are now taking ten times their former consumption.

T. L. Tallentire.

AN AID TO CHRISTMAS SALES

Christmas selling should be an easier task with the attractive window displays which the studio staff of the B.C.G.A. have designed for use by their members. It is a time when window displays form an irresistible attraction, and those which have now been designed adroitly exploit the gift giving spirit.

An artistic plaque for standing in the window or in the showroom draws attention to gas appliances as Christmas presents. It is in colours which reflect the spirit of the period.

This is an elaborate and highly topical Christmas tree display painted in full colours with the festive spirit well to the front. The selling point is emphasized by an actual gas fire which is relieved by gay figures which surround it.

The appeal that Christmas has to the children is well illustrated by this attractive gas fire display in which only the fire and guard are actual appliances. The three cut-outs of the children are painted in natural colours, and the ensemble forms an attention compelling display.

Value of Social Organization within the Gas Industry

By J. Leeming Robson, of the Birkenhead Gas Department.

The present economic depression is providing industry with an opportunity to examine not only the causes, but methods by which its evil effects may be best overcome, and, more important still, re-organization is becoming a potent force in an effort to prepare for the improvement in trade and market conditions.

Co-operation, therefore, becomes the keyword, and in no idle sense, because full co-operation between Capital and Labour is inevitable. Scientific examination of conditions in industry reveals that the rapid post-war developments in methods of production has not always allowed the introduction of facilities which would have assisted the worker to adjust himself to the more imposing requirements. Convenience, adequate rest, and physical comfort have not received consideration.

Reports of the Industrial Fatigue Research Board prove that the comfort of the worker has in almost every case brought about a greater output, with a corresponding reduction in working costs, a higher degree of physical fitness, and a more intelligent interest in the problems of industry.

The introduction of welfare work to factories and workshops is too often considered as an item of expenditure which offers little prospect of recovery. This is a fallacy, and for a complete understanding of the value of welfare work readers are recommended to study an illuminating work edited by Dr. Chas. S. Myers, Director of the National Institute of Industrial Psychology—" Industrial Psychology." No better evidence of the value of social and welfare structure within industry can be obtained.

The Gas Industry has in many of its undertakings developed the welfare side, but not always has it considered, as being worth while attempting, the organization of leisure. Without efficient organization the success of any venture is doomed to failure, and it is with this aspect of social organization that we are most concerned.

Practical experience always proves the best indicator, and readers may be interested in the development of social facilities which has been made in Birkenhead. No undertaking could have presented a more difficult problem; yet in less than two and a half years there has been evolved an organization which caters for every social and sporting activity. No other association can have provided for so great a variety of tastes. The success which has been achieved is nothing in comparison with the effect it has had on the Undertaking. Better relationships between every member of the management and the employees is the most pleasing factor, but the contribution that has been made towards the general improvement in the output has surpassed every expectation, indeed it has been claimed by the Chairman of the Gas Committee that a 5% increase in output and a corresponding decrease in the cost of production is attributable to the better atmosphere prevailing, and the influence of the Social and Sports Club.

That in itself is no mean testimony. This organization is yet young, but an indication of its achievements may be illuminating. There are over 400 members, each of whom contributes his weekly subscription through the Wages Book, and from this source there is obtained an income of £156 per annum.

Out of this sum the full equipment of cricket and football teams is provided, most of the expenses in providing a bowling green, and a sum of £36 per annum is set aside in a Special Reserve Account. Some indication of the success may be given by the fact that the Club provides a sports ground which accommodates football and cricket fields, three tennis courts, and two spacious pavilions.

For the winter comfort of the members, Club premises have been obtained in the form of an old building adjoining the offices, which has been reconditioned.

These premises provide a reading and rest room. Stewards' offices and stock rooms, billiards room with two tables, and a large concert hall which accommodates nearly 300 persons. A music and dancing licence will enable a full development of social functions, and at a later date it is intended to complete a stage which will enable the Dramatic Society further to develop its activities. While the Headquarters has been furnished out of income, the Special Reserve Account stands at over £100.

The reading room contains a collection of 250 library books, which allows members the best reading of up-to-date works at a cost which is one-third of that charged by any circulating library in the district. The addition of technical works is a matter which is at present being considered.

The Management of the Club is representative of each of seven departments, there being two members from each department, two *ex-officio* members in the persons of the Works Superintendent and the Outdoor Superintendent, and four executive officers. The inclusion of two *ex-officio* members holding positions of responsibility in the two sections of the Undertaking, Works and Distribution, enables the relationships made during the business hours to bear an indirect influence in the social life of the Undertaking.

A more detailed account would not add to the importance which has been attached to the existence of the Club. Not only has the Club achieved its main purpose, but it has cultivated the higher moral values of citizenship, and a better understanding of human relationships.

It is possible that other towns may be interested and willing to develop this side of the Undertaking's activity. Should this be so, and any information be desired, the writer will be glad to offer advice and help in any direction, provided application is made through the Engineer and Manager, Mr. J. Hood.

Bedford Gas-Works Social Club

Handsome New Hall Opened

Wednesday evening, Nov. 23, 1932, was a red-letter date in the hundred-years' career of the Bedford and District Gas Company, for it saw the fruition of a long-cherished project in the opening of the new Social Club, in Lawrence Street, Queen's Park, a building which, without hyperbole, can be described as second to none of its kind in Bedford. The Gas Company's Social Club has been in healthy and progressive existence for several years, and has contributed in no small degree to the " happy family " spirit which prevails in every Department of the Company; but hitherto the Club's activities have been somewhat cramped in a small building in the centre of the Works' yard. A great forward step was taken about three years ago by the laying down of the fine sports ground which is a next-door neighbour of the Bedford Town F.C. ground, and now the crowning achievement comes with the erection of this handsome Club House.

The inception of the scheme has had the cordial approval of the Directors, who are ever ready to lend their sympathy and support to any enterprise which may contribute to the welfare of their employees; but the driving force behind it, its inspiration, in fact, has been Mr. J. B. Hansford, the Manager. He it was who drew up the plans, and who set a lead that was followed enthusiastically by the Social Club Committee, and by everyone connected with the Company. For—and this is perhaps the most striking feature about it all—the whole of the work has been carried out by the Company's employees and with the Company's material. The imposing concrete blocks of which the building is constructed were made from clinker, and erected by the Company's masons; the woodwork was carried out by the Company's carpenters; tar breeze has been utilized to make firm paths round the hall. It is an entirely " home-made " building, and a splendidly successful result has been attained after eighteen months' team-work.

The concert hall is 70 ft. long by 30 ft. wide, and admirably proportioned. There is a lofty matchboard roof, supported by steel principals, and the hall is illuminated by four large lamps, which diffuse a soft, yet perfectly adequate light. The floor, in common with all the other floors in the building, is of Karrai, a reddish Australian wood, hard and durable, and capable of taking a high polish. The proscenium is well constructed of lath and plaster, and is painted light blue, and surmounted by the Bedford eagle and castle. The hall seats 350 people, and there is dancing room for 200. The heating is supplied by coke-fired hot-

water radiators, and all the pipes run round the outside of the building so as not to interfere with the floors.

Opening out of the entrance hall are the bar, the reading room, and the billiard room, all admirably fitted, well lighted, and comfortable. One of the features of the bar is a Stott boiler of chromium plate, which delivers hot water in two minutes.

Along the whole of the side of the building, looking over the sports field, is a broad verandah, glass covered, which will make a delightful sitting-out place on fine days.

The new hall, beyond its facilities for recreation, concerts, dances, &c., will be used as a centre for the other welfare branches controlled by the Executive Committee—the sports and music sections, the sick benefit club, the coal club, the benevolent fund, the holiday fund, &c. Each of the employees contributes a penny a week to the Social Club, the Benevolent Fund, the District Nurses, and the Workers' Hospital Fund, and the results obtained have been most beneficial and encouraging.

The Opening.

The hall was packed with employees and their relatives for the opening and concert on Nov. 23 last. For the opening ceremony, the Rev. Paul Wyatt, M.A., J.P., Chairman of the Company, presided, supported by co-Directors, Major A. W. H. Lees, Mr. G. C. Walker, J.P., Col. G. Hayward Wells, T.D., D.L.; Mr. J. B. Hansford (President of the Social Club), Mr. R. Turner (Chairman of the Executive Committee of the Social Club), Mr. C. H. Allen (Hon. Treasurer), and Mr. J. W. Deaton (Hon. Secretary). Among those also present were the Mayor and Mayoress (Alderman and Mrs. S. B. Morling).

The Rev. Paul Wyatt said: "This evening marks the realization of a dream by some of us many years ago. Just as our Co-Partnership Scheme made the interest of employers and employed one by our all becoming shareholders in this Undertaking, so the provision of this building, the crown of our Sports' Ground, finally cements the good will of all of us. On behalf of my colleagues, I now formally entrust the use of this building, with its business room, billiard room, bar and entertainment room, to the Committee of Management. I know you, on your part, will prize it and be worthy of it." The Chairman then handed the key to Mr. Deaton as Secretary of the Social Club.

Mr. Hansford thanked the Chairman and his co-Directors for this very handsome building, which he was sure would be very greatly appreciated by all the co-partners.

The Mayor said he accepted the invitation to be present because he felt he was going to see something new for Bedford and that behind this effort there was a spirit of good will on the part of Directors and everyone connected with the Company. It was an example which he hoped would be followed in many other directions.

A Spur to Business

Gas Exhibition at Lincoln

In organizing an Exhibition of Gas Appliances just at the time when we hear that the East Midland Electrical Grid is on the point of completion, the Lincoln Corporation Gas Committee have accepted the challenge in the right spirit.

In Sir Francis Goodenough's speech, reported in our last issue, a well-earned compliment was paid to the enterprise of the Gas Committee in staging this Exhibition, particularly as the district had suffered almost as severely as any other area in the economic crisis.

At the opening ceremony the chairman of the Gas Committee (Councillor A. L. Bower) presided, and was accompanied on the platform by the Mayor (Alderman J. W. Rayment), the City Sheriff (Mr. T. O. Clapham), Mr. W. T. Bell, Mr. G. R. Sharpley, Mr. Victor Bone, Mr. George Wright, the Engineer and Manager of the Gas Department, and members of the Corporation, Mr. G. Dixon, Engineer to the Nottingham Corporation Gas Department, Mr. H. M. Thornton, of Radiation Ltd., and others.

The Chairman mentioned that the new 3-million works commenced in January last had just been put into operation, and that these works were equal to the best in the country. A due meed of praise was given to the Engineer and Manager (Mr. George Wright) for the admirable way in which the works had been planned and for the indefatigable energy that he had shown in the project. The example of the Gas Industry was certainly encouraging. Despite the keenest competition from electricity, it was to-day seen to be more efficient than ever in expanding its production and in the variety of its services. The secret was that the Gas Industry made itself indispensable. It increased the standards of home comfort and leisure, at least as much as any of its rivals, if not more. Councillor Bower referred to the presence of Mr. H. M. Thornton, J.P., of Radiation Ltd., which firm had co-operated so heartily in organizing the Exhibition.

Proposing a vote of thanks to Sir Francis Goodenough, the Mayor said that, as Chairman of the Electricity Committee, and Mayor, he was proud to be there. Like, Sir Francis, he believed there was plenty of room for both gas and electricity.

Mr. Thornton proposed a vote of thanks to the Mayor and also to the Sheriff of Lincoln, thanking them for their presence and interest in the Gas Department's efforts to popularize still further the use of gas. He said that the Exhibition and the Cookery Demonstrations which Sir Francis Goodenough had inaugurated would be invaluable to the gas consumers of Lincoln. It would enable them to see the wonderful progress made in all kinds of gas apparatus. It would bring home to all thinking people the economy and comfort of gas for cooking and heating, and to the manufacturer the many industrial uses of gas.

The vote of thanks was seconded by Mr. George Dixon, who also paid a tribute to the energy and foresight of the Committee and their Engineer in what they were doing to further the cause of gas in Lincoln.

INSTITUTION OF GAS ENGINEERS

Written Contributions and Authors' Replies to Discussions at the Autumn Research Meeting

Ten Years of the Education Scheme

9th Report of the Gas Education Committee

Mr. Walter Hole.

Mr. WALTER HOLE (Torquay) writes:

It is ten years last June since the Education Scheme was tentatively accepted by the Institution and referred to the District Associations for consideration and comment. Subsequently an Organizing Secretary was appointed, part of whose duties were to expound, recommend, and, in some cases, defend the Scheme.

It is an interesting exercise to cast one's mind back over these years and compare 1922 with 1932. The first outstanding fact is that the root and branch objections met with in those early days are no longer heard. Some of these were purely selfish. Some were ill-advised and ill-considered and some were due to misunderstanding. I think that what has been done more than anything else to kill these has been the procession of fine young men who have come up year after year to receive their Diplomas at the hands of the President. All must feel that with such recruits the prestige, dignity, honour, and success of the Industry in the future is fully assured.

Then as to the Scheme itself. Anyone who will take the trouble to compare the original handbook of 1922 with that of to-day will find a wonderful development. In 1922 there were no Minor Courses, no Gas Fitting Courses, no District Committees, no liaison with Leeds University, and no Teachers' Courses. The syllabuses have been re-arranged and the study of Ancillary Subjects developed. It will be within the memory of many of us that when the Scheme was submitted to the Institution in 1922 there were some who criticized this or that provision. The answer given was, "Let us get the Scheme working. We can then introduce improvements as experience dictates and remove any anomalies which may reveal themselves. If we do not make a start until all agree we have a perfect Scheme, we shall never make a start at all." The three or four revisions which have taken place during the ten years are sufficient evidence of the scrupulous care with which that implied pledge has been kept.

The Report we are now considering shews how wonderfully widespread the adoption of the Scheme has been. It shews that no less than 87 Technical Colleges have adopted the Scheme in one or more of its parts, and in these 87 Colleges no less than 190 Courses in different subjects have been approved.

But although the number of centres giving instruction in gas subjects is growing so satisfactorily, it still falls far below what is necessary. If a line is taken south to north from Southampton, through Derby and Leeds, to Newcastle, there are only four centres, excluding London, namely, Luton, Leicester, Hull, and Barnsley, to the East of that line which have approved Major Courses. Nine have Minor Grouped Courses, and only 25 have Courses in Gas Fitting. All must agree that this provision is altogether inadequate. From the Gas Education point of view the eastern half of England is starving. Making full allowance for the fact that this eastern half is mainly agricultural, it still is difficult to understand why there are not sufficient potential students within reach of such centres as Norwich, Ipswich, or Lincoln to justify the formation of classes.

When we turn from the centres to the students we find that the numbers are increasing very satisfactorily. In the year 1924, after two years of hard spade work, there were only four Technical Colleges which were in a position to send up candidates for the first examinations held under the Scheme, although 7 others had commenced work on Approved Courses. These 4 Colleges entered 35 candidates who, together with 24 external candidates, made a total of 59 for examination. Of these 42, or 71 per cent., were successful.

This year there was a total of 424 candidates for examination in the Major Courses alone, and of these 339, or 77·8 per cent., were successful. But this is only part of the story. To obtain a true idea of the progress made, we must add to these 424 the candidates examined in the Minor Grouped Courses and in the various grades of Gas Fitting. When this has been done, we get a total of no less than 2106 candidates who have been examined in 1932 under the Scheme. Regarded simply as evidence of growth, these figures are remarkable, but when the high standard attained is also considered, they must be regarded as extremely satisfactory.

When the Consultative Committee met at Birmingham last year, attention was called to the fact that so far no award of the Diploma in Gas Supply had been made. As a result of observations then made and subsequent discussions, the Regulations and Syllabuses dealing with the Supply Section have been thoroughly overhauled, re-drafted, and re-arranged. The new Regulations provide for a Syllabus for the Supply Diploma and also for bringing it into line with the Diploma in Gas Engineering, so as to entitle the holder—other requirements having been met—to corporate membership of the Institution. In future it will be known as the Diploma in Gas Engineering (Supply). Everyone engaged on that side of the Industry will look on this as a very welcome development, and in this connection I should like to voice the great satisfaction we all feel that at last two of our students have obtained this Diploma.

In conclusion, I should like to emphasize that sentence on page 4 of the Report which states that "the examinations held under the Education Scheme are definitely recognized as an essential part of the training of the Gas Engineer." In the early days one was often met with the remark, "Why should I take this Gas Course. Others before me have not done so, why should I go through the mill?" Such remarks were always a sign of mental indolence and the inexorable logic of stern facts was bound to play havoc with such an attitude. We are all glad to know that these examinations are now universally recognized as an essential part of the Gas Engineer's training.

The past decade has, therefore, been one of steady and ordered progress. The Education Scheme has become deeply rooted in the Industry, and the advance already made is a happy augury for a still greater success in the future.

Inspection and Insurance of Gasholders

1st Report of the Gasholder Sub-Committee

Mr. William Blakeley.

Mr. WILLIAM BLAKELEY writes:

In regard to the inspection and maintenance records of gasholders, as enumerated in Appendix II., I would like to say that whilst many of the items are applicable to both column and spiral-guided gasholders, I think it would have been better if these two classes of gasholders had had separate items, and also one in respect to gasholders of the waterless type.

In respect to gasholder maintenance, there is one point to which attention should be given in so far as relates to multiple lift gasholders. In the case of spiral-guided gasholders, the inner lift in many cases seldom comes into actual operation (by which statement I mean that this lift in the majority of cases is fully inflated over long periods) and therefore is very infrequently cupped and uncupped. This means that the spiral carriages guiding this lift do not function during these periods, and on account of being out of action so long the lubricating oil in the axles will dry up, with the likely possibility that weather and rain will percolate through and set up corrosion, so that when it is necessary for the inner lift to function the rollers or axles of these carriages are apt to be fast and thereby not revolving as they should. The inevitable result is that when the lift does come into action the spiral rails may start sliding by reason of the rollers being tight.

In this event the grooves of the rollers get flats worn on them, which eventually make matters worse in regard to the tendency of holding the rollers up. I have known of gasholders—where rollers had not functioned for a long period—where flats as much as 3 in. long had been worn in the grooves of the rollers. I have known cases also where this trouble has arisen of the rollers and spiral rails being greased—with a view no doubt to helping matters—this further inducing the sliding action instead of the rollers and axles being made free. Therefore in my view it is the duty of the Engineer to see that a responsible person should go round the carriages and oil them at reasonable intervals to enable the oil film to spread over the axles or bearing surface, and thus keep the carriages in such a condition that when the occasion arises for the different lifts to come into action they will function smoothly and not become hard and fast as in many cases does happen.

In regard to the question of tank or lifts being out of level. If there is some subsidence in connection with the tank of a spiral-guided gasholder this, within limits, is not so serious as would be the case with a column-guided gasholder, as in the spiral-guided type only one set of carriages is in action at a time. For example, in a multiple lift gasholder of the three-lift type, the inner lift on rising is guided by the carriages on the middle lift which are at tank level. When the middle lift rises the carriages on the outer lift come into action, these also being at tank level. When the outer lift is picked up the tank carriages themselves come into action so that, within reasonable limits, when a tank to this type of holder is slightly out of level the gasholder will still work smoothly, but of course as soon as possible after such faulty level is discovered, the carriages should be adjusted to compensate for this.

In the case of a column-guided gasholder, however, where the tank has got out of level, the trouble might be more serious by reason of the height of the columns, and more so if there is a leaning over of the columns in different ways. For instance, if a column is ½ in. out of plumb near the base it will be very much further out at the top, and the guide pulleys of the inner lift, though possibly correctly adjusted when the lift is down, are more than likely to be away from the guides altogether when the gasholder is fully inflated.

Mention is made in the Report in regard to cup deposits, but nothing is mentioned in respect to tank deposits, and where brick or concrete tanks are provided with the top of tank at ground level, as is more often the case, it is a matter of no small difficulty to prevent rubbish and dirt of all kinds from getting into the tank. I recall one case in connection with a large gasholder I had to deal with that the accumulations in the tank were so great that a horse and cart had many journeys to make to get this completely cleared away before the cupping of the replace gasholder could be fixed.

In a more recent case I found that a gully carrying rain water down a hill side had been connected to the gasholder tank, no doubt for the purpose of keeping the tank full of water. When this tank was emptied for the purpose of replacing the gasholder there was as much as 4 ft. of mud and rubbish around this portion of the tank to remove, and the old gasholder for quite a long time had never properly seated itself when down.

Conditions such as these in the bottom of a tank are obviously going to create trouble, particularly in a gasholder of the column-guided type, because when the lifts are down the bottom and cup carriages go down into the mud, this getting into the bearings of the axles and causing considerable wear.

It is certainly an admirable idea occasionally to put a recording pressure gauge on a gasholder, but when this is done the best records are obtained by starting the gasholder from the bottom and putting gas in until it is fully inflated, then deflating the gasholder again down to the bottom. The resulting chart would be a better indication of where the various lifts are possibly sticking than if a recording pressure gauge was put on whilst the gasholder was actually supplying gas to the town, whereby at times it would be falling and at others rising. If the gasholder was raised steadily and directly from the bottom to the top and lowered again without any intermediate alteration of direction, then factors of great interest would more likely be found from the examination of the recording chart.

In connection with the inspection of gasholders, it is certainly best to have a practical man experienced in gasholder construction for such duty, but at the same time the Engineer or Manager in charge has often a better opportunity of knowing how the gasholder behaves in critical conditions, such as, for instance, when there is a strong gusty gale of wind, and this is the time when the Engineer on the spot can form an opinion on the weakness or strength of the various parts of the gasholder.

Quite possibly some of the above points have already been noted by members of the Sub-Committee, and in view of the fact that the Report in question is the first it is very probable that the Second Report when issued may deal with these and other important matters relating to gasholders.

Mr. Thomas Hardie.

Mr. THOMAS HARDIE, Chairman of the Gasholders Sub-Committee, in reply, writes:

Mr. Blakeley's contribution is of great interest, as he raises a number of points gained by long experience with the operation of gasholders.

The inspection record was put forward with the intention of presenting a series of headings applicable to either the column guided or the spiral type of holder, and it is not quite apparent in what respects Mr. Blakeley considers it inadequate for the purpose. The waterless gasholder needs an entirely different form, and such a one is in the course of preparation.

The point raised with regard to the spiral carriages guiding the inner lifts of spiral-guided holders, which may only function at infrequent intervals, is important.

In Appendix I., Section 3, Quarterly:

(*b*) Condition (especially as to tightness and greasing) of Rollers and Pins,

actually covers the inspection suggested. To enable such an inspection to be of value, the inner lift guide carriages should be brought into action.

Although the First Report does not stress the necessity of periodically completely raising and lowering the holder at stated intervals, the value of such a test is worthy of attention by the Sub-Committee, more especially if Mr. Blakeley's further suggestion was adopted of recording the pressures shewn during such operations.

The Gas Light and Coke Company has found that with waterless holders such a test is of considerable help in estimating the correct setting of guide rollers.

It has been assumed by the Sub-Committee that if at a quarterly inspection the tank of any type of holder was found to be out of level, the matter would be fully investigated by a person thoroughly competent to judge whether the holder was in a fit condition for further service—having regard to its type and construction—without adjustment or repairs.

The matter of tank deposits has already been raised and will be included in any revision.

The Back-Run Process

31st Report of the Joint Research Committee

Mr. C. S. Shapley.

Mr. C. S. SHAPLEY writes:

I would like to pay tribute to the thoroughness and ingenuity displayed in carrying out the work necessary to furnish the Report we have just heard. The originality of the methods used in surmounting the difficulties met with, and also the clear explanation of phenomena as on pages 82 to 87 are a testimony to the ability of Dr. Dent and his colleagues, and I must congratulate them on presenting a Report which fully maintains the high standard expected by The Institution of Gas Engineers.

The primary object of the Report is the examination of the Back-Run Process, and the information given is very valuable in providing our Institution with reliable data with regard to the process and not leaving our members to rely simply on conjecture, optimistic or the reverse.

Of equal importance is the fund of information given which is applicable to all existing water gas operations and which if carefully studied will lead to greater efficiency in the general working of water gas plants.

On pages 82 to 87 Dr. Dent deals with the mechanism of the reactions occurring in the fuel bed of the generator and gives his reasons why the Back-Run Process increases the efficiency of the fire, resulting from a restricted CO formation during the " blow " period. In effect, he is increasing the depth of his combustion zone by the partial de-oxidation of his " blow " in the relatively low-temperature zone of the generator near the firebars, and this reduces the intensity of combustion in the upper zone of the fire.

In the ordinary operation of a water gas generator, combustion will probably be taking place in a zone of something less than 9 in. depth, resulting in the intense clinker formation of which most are familiar and which is an important retarding factor in the efficiency of the fire. On clinker formation you get channels forming at the interstices in and between lumps of clinker, and at these points increased velocity of the " blow " gases occurs which creates intense localized combustion resulting in high CO formation, and whilst an automatic clinkering device for breaking up the clinker will play a considerable part in improving the fire by spreading combustion over the whole face of the fuel bed, I am of the opinion that the delayed combustion as described by Dr. Dent is the object to be aimed at and I would ask Dr. Dent if he could suggest a modification in working existing plants that would achieve the same object.

The delayed combustion theory is a very ingenious hypothesis and one which will help others to improve the working of their generators. Whilst I fully agree with the theory that the partial de-oxidation of the " blow " is the reason for the good results obtained with the Back-Run Process I am not convinced that it is brought about by primary combustion of coke at a low temperature for the reason that the greatest difference existing in the state of the fire at the end of " back-run " compared with the end of a " down-run " will be the temperature at the bottom of the fire which in the case of the " back-run " will be the hotter, and I would assume that the temperature gradient in both fires will be similar except that the gradient in the " down-run " fire corresponding to that in the " back-run " fire will be nearer the middle of the generator. Therefore the greatest difference to account for the higher efficiency is the hotter state at the bottom of the generator. This corresponds with the clinker zone and I suggest that the hot clinker may be the factor bringing about the partial oxidation of the blow gases. I am assuming the top half of the fire is heated by convection in both cases, and am therefore leaving it out of consideration. It would be interesting to know whether Dr. Dent has had an opportunity of confirming the mechanism of his theory.

Dr. Dent has shed quite a lot of light on water gas practice and has provided reasons for many of the curious happenings one hears of with regard to water gas practice such as clinker formation half way up the generator, high percentage of coke in clinker, relatively cold carburettors and excess of blow gases burning at the stack, &c., and we are indebted to him for a very interesting and instructive Report.

What are the factors he uses for determining the periods of his " blow " and " run "?

Dr. Dent's Reply.

Dr. F. J. DENT, in reply, writes:

The interesting discussion on the 31st Report was gratifying to the research staff and I should like to express my appreciation of it. Some of the contributions were made by way of comment, others by way of criticism, but some, in suggesting comparison of the results of the Report with those in Reports published previously, use our results for a purpose for which they are neither intended nor suited.

Proper Function of the Results.

It becomes necessary to emphasize that the Nine Elms tests were made with the aim of investigating the influence of supplying the generator with highly superheated steam according to that process known as the Back-Run Process. The Report is essentially self contained in that it gives experiments made with and without the back-run, under otherwise similar conditions and on the same generator. The influence of the superheated steam is obtained by the consideration of these two series of experiments. It is important to realize that the comparison of the present results with those of the previous Reports on water gas (viz., the 6th, 7th, and 10th of the Gas Investigation Committee) does not shew the gains obtained by using back-run steaming, since the tests in the earlier Reports mentioned were made under entirely different conditions; for example, the generators were not equipped with self-clinkering grates and annular boilers and, in the 6th and 10th Reports, blue water gas was prepared.

For this reason I do not agree with **Mr. Hollings** when he states that the back-run process is viewed in proper perspective by comparing the present results with figures published previously for tests on brick-lined generators. For the purpose of assessing the value of using superheated steam, I do not think that this is so. Indeed, if such a comparison had been thought possible, the tests at Nine Elms would not have been carried out as the results obtained on the back-run plant at Stratford were available (*vide* 27th Report of the Joint Research Committee).

In making the comparison with the results of brick-lined generators, Mr. Hollings does not bring out the saving in coke due to the back-run, but the saving of the back-run less the increase in coke consumption due to jacketing the generator with a boiler. These are two entirely different questions and only the former has received consideration in the Report. The questions are different from the practical as well as from the theoretical point of view; the back-run is used in some brick-lined generators, and also, down-run plants are fitted with self-clinkering grates. Since however in modern plants both these modifications are usually incorporated together, it is of interest to know the net effect of both. But the present tests cannot be used for this purpose since they do not represent the most modern practice. The plant at Nine Elms was erected in 1924 at a time when the inclusion of the annular boiler and self-clinkering grate in the design of a water gas generator was not fully developed, and since that time further improvements have been introduced which have emphasized the advantages of these modifications and reduced their disadvantage of increasing the coke consumption. No claim is made that the test performances on the hand-operated plant at Nine Elms represent the most modern practice, indeed, on automatic plants working on a shorter cycle they can be readily improved upon. Comparison of the present results with those published previously can only be regarded as shewing the influence of modifications introduced some years ago and, in view of the later improvements, such a comparison has to a large extent lost its interest and value.

On the other hand the construction of the plant did not interfere with or detract from an investigation of the Back-Run Process for using superheated steam. By operating the plant with and without the back-run, results were obtained which show the influence of superheating a known proportion of the steam supplied and they can be applied without reservation to all water-sealed generators.

Differences introduced by water-cooled self-clinkering grate.

As suggested in the Report, some revision to the extent but not to the nature of the conclusions given may be necessary when considering the use of the back-run in brick-lined generators; the disadvantages of using steam

without superheat in generators of the latter type is not so marked owing, firstly, to a greater ease of maintaining an adequate temperature in the lower zones of the fuel bed and, secondly, to a reduction in the heat absorbed from the carburettor by the hotter blue gases leaving the base of the generator.

Since it was to be expected that the cooling of the generator by an annular boiler would increase the coke consumption, its general adoption must mean that its attendant advantages more than outweigh this disadvantage. Mr. Hollings refers to these advantages but does not emphasize them, and I think that the tone of his remarks does not reflect the considerable advances, in both efficiency and ease of working, which have taken place in recent years. I think it will be well to consider the tests on a somewhat wider basis.

A serious disadvantage of hand-clinkered brick-lined generators is the fluctuating condition of the fire and the arduous labour involved in the removal of the ashes, &c. To overcome this difficulty, the makers of the plant tested, Humphreys & Glasgow, Ltd., chose a self-clinkering grate which embodied water seals round the generator base and depended on the presence of an annular boiler which, in addition to raising steam, prevented the adhesion of clinker to the walls of the generator. Experience has shewn that the ashes and clinker removed from the fire by such a grate are associated with a smaller amount of combustible material than was usually present in the ashes when they were removed by hand. This saving did not compensate however for the heat absorbed from the generator by the boiler and, as a whole, the adoption of the boiler and self-clinkering grate led to an increase in the coke consumption.

It was plain that the influence of the heat absorbed from the generator by the boiler should be reduced as far as possible, and it was found that this could be done by increasing the rate of gas production per square foot of generator cross-section. Comparison of the operating conditions of the plant in the present tests with those given in the previous Reports of the Committee shew that the increase has been obtained by modifying the cycle and using a higher blast pressure.

A further way to counteract the increase in coke consumption brought about by the generator boiler was to use back-run steaming. The extent to which this method of operation was effective is shewn in the Report and it was found that the heat returned to the generator in the back-run steam reduced the amount of heat to be liberated in the fuel bed by blowing and, as a result, increased the throughput and reduced the coke consumption by more than 10 per cent.

It is the net result of all these modifications which is brought out by the comparison of the present Report with previous Reports on brick-lined generators. For reasons already stated I do not think that such a comparison is of great value.

The 7th and 10th Reports.

There is one point in this connection to which attention must be drawn. Mr. Hollings has compared our results with his own test on a brick-lined generator and also with Dr. Parker's results given in the 10th Report. I do not know the conditions which prevailed in Mr. Hollings' test, but it should be pointed out that the comparison with the 10th Report cannot be made. The 10th Report describes tests on a *blue* water gas plant, on which, as a result of the absence of the resistance thrown by the carburettor, superheater, and waste heat boiler, the rate of air supply, per square foot of generator cross section, during the blow periods, was considerably higher than in the present tests, in spite of the lower blast pressures used. This was one of the reasons why, in the 10th Report, it is seen that the blow periods were approximately of only half the duration of the corresponding periods in the tests at Nine Elms. Also, in all the tests of the present Report, excepting Test 2, the requirements of oil cracking governed the nature of the cycles used. There is no doubt that if a similar high rate of air supply had been used in the present tests and no attention had been paid to the conditions in the carburettor and superheater, higher efficiencies could have been obtained throughout.

The tests in the 7th Report are more comparable, being tests on a carburetted water gas plant. In this case a two-minute blow was used as in the tests at Nine Elms. Again, however, the rates of air supply are different, being now higher in the case of the Nine Elms plant, but since this is due to a higher blast pressure it can be regarded as being one of the " modern improvements."

The following Table compares the best test of the 7th Report with Test 2 of the present Report, the back-run test using a cycle suited to the production of gas of the same quality, viz., 480 B.Th.U. per cu.ft.

Table Comparing Results of the 7th and 31st Reports of the Joint Research Committee

—	Test 3, 7th Report.	Test 2, 31st Report.
1	2	3
Coke consumption (dry), lbs. per 1000 cu.ft. blue water gas.	42·05	36·69
Ash in coke	10·4	8·6
Rate of blue gas production during run periods, cu.ft. per square foot of generator cross section	29	45*
Rate of air supply during blow periods, cu.ft. per square foot of generator cross section	124	154
Blast pressure, inches water gauge	13·3	20·2
Per cent. CO_2 in blow gas.	12·2	14·1
Steam raised in generator boiler, lbs. per 1000 cu.ft. blue water gas	*Nil*	32·6

* In all the rates given under the heading " cu.ft. per minute per square foot of generator cross section " on page 148 of the Report, the decimal point has been omitted. The figures tabulated are ten times too large.

In this Table the generator in the back-run test shows a considerably improved performance. The coke consumption is approximately 5 lbs. less, after taking into account the differences in ash content, and, in addition, 32·6 lbs. of steam were raised in the annular boiler, an amount which is in itself equivalent to 4 lbs. of fuel. The saving does not represent that due to the back-run alone. The figures for the percentage of carbon dioxide in the blow gases shows that it was also due to a greater efficiency of blowing. This greater efficiency was obtained in spite of the 55 per cent. increase in the rate of gas production during the run periods. As pointed out however such a comparison is of no great value. The tests in the 7th Report represent the performance of a modern brick-lined generator no more than the Nine Elms tests are typical of the latest self-clinkering practice.

I note that Mr. Hollings in his comparison of the tests makes no allowance for the steam raised in the annular boiler. This item is to some extent counterbalanced by the reduction in the amount of steam raised in the waste-heat boiler, but, when considering the performance of the generator, it should be taken into account.

Recent Improvements in Water Gas Practice.

The further advances in the design of water gas plants which have been made since the plant at Nine Elms was erected might be briefly referred to.

The steady conditions in the fuel bed resulting from the use of the self-clinkering grate and back-run have made automatic operation possible. Automatic operation in its turn enabled the plant to be operated on a shorter gas-making cycle, and this was an important step towards greater efficiency and increased throughput. The greater efficiency followed from the shorter time of the individual blows. With a comparatively long blow the efficiency of generating heat in the fuel bed is limited, since, as the blow progresses, zones of high temperature are formed with a consequent production of considerable amounts of carbon monoxide in the blow gases. On the other hand, with the short blows used in the recent 2½-3 minute gasmaking cycles, the tendency for the localization of high temperature is diminished. Thus, in spite of working modern generators at a higher *average* temperature in the fuel bed, as indicated by the higher rate of gas production, it has been found possible to reduce the percentage of carbon monoxide in the blow gases. These developments have undoubtedly reduced the coke consumptions of modern plants to a figure below those obtained in the tests of the present Report.

I am not quite clear about Mr. Hollings' implication when, in referring to the condition of the fire, he points out that the condition of the fire " is surely dependent upon the cycle." I heartily agree and would say that the condition depends almost completely on the cycle, and, in the appendices of the Report, an attempted explanation is given of the relationship between the two.

Factors Influencing the Cycle.

Mr. Hollings also raises the question of variation in the time of blowing. At Nine Elms, the five-minute cycle was split up into approximately a 2-minute blow and a 3-minute run, but in some tests the blow period was rather longer than in others; Mr. Hollings calls attention to the fact that the blow was longer in Test 1 than in Test 2. Since this matter was also referred to by late speakers, I should like to emphasize that, during the tests, the time of blowing was fixed by the heat requirements of the run. In Test 1, once the time allowed for oil injection and clearing the oil vapours had been decided upon, it was found that, if the output of the plant was to be maintained, a blow of a certain duration was required. In Test 2, owing to the

greater amount of heat returned to the generator in the back-run steam and also as a result of improved conditions in the fuel bed, a shorter blow could be used without losing throughput; indeed, in spite of the shorter blow in Test 2, the make of blue gas per day was greater than in Test 1.

It has been noticed that in some, but not all, automatic sets working on a short cycle, the proportion of the total time used for blowing has been increased above that used in hand-operated sets working on a longer cycle. The increased proportion of blow is accompanied by higher steaming rates during the run, and the procedure has been adopted with a view to increasing the output and reducing the proportion of the heat which passes to the generator boiler. The use of such a modification has to be watched with care if undue loss of efficiency is to be avoided. Increasing the proportion of the blow above a certain amount tends to counteract the advantages to be gained by shortening the cycle, and, in restricting the run, reduces the time available for oil injection. In the test described in the 27th Report on the automatic plant at Stratford, the blow occupied 44 per cent. of the total cycle time compared with approximately 35-40 per cent. in the present tests.

Working Results at Nine Elms.

I thank **Mr. Cunnold** for his remarks on the work of the Research staff and was pleased to hear his opinion of its value. In the main Mr. Cunnold's contribution was in agreement with the findings of our tests, but there is one point I wish to make clear. In the Report figures are given for " dry coke supplied to generator " and for " carbon as coke supplied to generator." These figures are working results. The dry coke figure represents the dry coke contained in the wet coke supplied, and similarly the carbon figure gives the amount of carbon in the wet coke. They are not hypothetical figures, as I gather Mr. Cunnold supposes, calculated from the test results on the assumption that the ash and moisture had not been present. Thus the reduction in coke consumption brought about by the back-run and shewn in the Report, represents the reduction actually obtained.

Mr. Cunnold points out the increased difficulty of making full use of the back-run as the calorific value of the carburetted water gas increases. For reasons given in the Report, I think, however, that, under such circumstances, the advantages of this method of steaming can be obtained if the difficulty is fully appreciated.

Automatic Recording of Gas Flow.

Dr. King mentions our " laborious " method of measuring the gas volumes of cycles by 5 sec. observations and refers to his automatic apparatus. I thank Dr. King for demonstrating his device to me before the tests were made, but I would point out that whether or not time is saved by such an instrument depends on circumstances. The apparatus required making and testing and also dark-room facilities. It so happened with us that the time before the tests was of more value than that following them, and, in view of the considerable amount of other necessary preparation, I did not hesitate to regard the method of measuring the gas volumes as a point of minor importance. I think I should make the same choice of method again, since direct observation is more positive. Dr. King's apparatus is probably more suited to the Research Station than to works use.

Clinker Formation.

I was interested in Dr. King's remarks on the operation of a water gas generator under conditions in which no clinker is formed. This I gather depends primarily on limiting the temperature attained in the fuel bed. It would have been enlightening if Dr. King had told us what influence such limitation had on the output of the plant, for this consideration is of major importance in the case of water jacketed generators. Any extensive reduction in output would lead to a loss of efficiency as a result of the increased proportion of heat passing to the generator boiler. The self-clinkering grate itself greatly reduces the detrimental influence of clinker formation in preventing it building up across the combustion zone.

Purging.

Dr. King also draws attention to the loss of gas during the purging periods. I know of no point in the design of the carburettor and superheater which was introduced to avoid turbulence during the purge. The domed linings of the carburettor and superheater will, of course, make purging more complete, but their effect will be small. A little gas is undoubtedly lost when the stack valve is opened, but I think the loss is due to an imperfectly fitting stack valve rather than to incomplete purging of the cracking vessels. Surveys made at Stratford of the composition of the gas at the top of the superheater indicated that the purging process is itself fairly complete. The figure put forward by Dr. King for the possible increase in the hydrogen content (2 per cent.) appears to be high. The figure corresponds to a loss of 4 per cent. of the gas. In the case of the plant at Nine Elms, the loss would only be 5 per cent. if no purging at all took place; the loss would, of course, increase with a shorter cycle time.

In discussing the flow of the gases through the carburettor and superheater, it may be mentioned that the makers of the plant tested, Humphreys & Glasgow, Ltd., have paid considerable attention to *increasing* the turbulence of the blow gases and secondary air at the top of the carburettor in order to promote more efficient combustion at this point and improve the temperature distribution in the cracking chambers.

Constant Rate of Air Supply.

Dr. Parker puts forward the suggestion of comparing the results of the present Report with those of the 6th, 7th, and 10th Reports. The reasons why this was not done have already been dealt with; the nature of the tests made at Nine Elms made the Report self-contained.

Dr. Parker also questions the experimental procedure and points out the dependence of the conditions in the generator on the rate of air flow. There were small differences in the rate of air flow during the various tests and in the Report it is shewn how these differences were allowed for. Dr. Parker asks us not to take his remarks in the nature of a serious criticism, and I agree with him that they are not to be regarded as such, since the variations in air flow during the tests were sufficiently small as to have no influence on the nature of the conclusion to be drawn from the results, whether or not allowance was made for them. The tests shewed that back-run steaming led to an increase in the volume of gas made per day. The variations in air flow did not hide that conclusion. They influenced the extent of the increase, but not to a serious degree. In any case, the use of the positive blower which Dr. Parker suggests would not be practicable with a water-sealed generator of the type tested. Apart from the influence of temporary variations in the resistance thrown by the fuel bed, at the commencement of the blow, the blast is admitted against the resistance of the washbox and the relief holder pressure. Any attempt to use a positive air flow would have " blown " the water seals. The alternative was to test the back-run process on a brick-lined generator. Even if the use of a positive blower did not present practical difficulties in that case, the results obtained would have been of less value, since back-run steaming is becoming more and more employed on water-sealed sets, where it is probably used to the greatest advantage. Dr. Parker thinks that the refinement of a positive blast was necessary to " measure the small differences which can be expected to result from superheating steam in the down-run; " but the difference was not small. In Test 2 the heat returned to the generator in the back-run steam was equivalent to 12 per cent. of the heat liberated in the generator during the blow period and used in gas-making. There was no difficulty in detecting the influence of such an amount of heat.

Bases of Comparison.

Dr. Parker then proceeded to consider the tests separately, and finally there remained only two tests which he thought comparable and as representing the " best conditions " of the respective methods of steaming. If the Report is read in that way I think its use will be considerably diminished. Neither the experiments themselves nor the Report describing them were made in such a way that it could be said that " these are the best conditions for the back-run, these are the best conditions for the down-run, a direct comparison will show the absolute difference between the two." Such a method of approaching the problem is not, I think, a feasible one. Rather was the question regarded in the light that back-run steaming returns an amount of heat to the generator which will make itself apparent in a number of ways, and we endeavoured, by making the tests as complete as possible, to show the various ways in which this additional source of heat influenced the working of the generator. We considered it as important to obtain a complete picture of the process as to arrive at definite figures measured as lbs. of coke or cubic feet of gas per day. Figures are always bound to some extent to the conditions under which they are obtained, but a realization of the nature of the process is applicable to all plants and can be put to immediate practical use. I do not wish to suggest that the data obtained cannot be employed as such, but rather to point out that they attain their greatest value only when considered fully in relation to the conditions prevailing during the tests.

There are no " best-conditions " for the operation of a water gas plant. The Engineer not wishing to instal new

plant can use the back-run to increase the capacity of existing sets, whereas under other circumstances the possible saving in coke may be the more important. All the conditions between the two possible extremes could not be investigated, and it was thought that the Report would have greater usefulness if steady working conditions were examined in detail, leaving Engineers, on the basis of their experience, to fill in the necessary gaps in the range covered by the experimental data.

As an example of the impracticability of standardizing conditions in comparative tests such as the Report describes, the remark made by Dr. Parker in discussing Tests 2 and 4 will be considered. He states that " But in comparing these two tests we find . . . that there was a difference in the blow gas, indicating different conditions of cycles." But there was no reason why the blow gases should have the same composition. A water gas generator is blown with air in order to liberate the sensible heat required to decompose the steam during the run. Back-run steaming, however, is another operation which leads to the same end. Consequently, as soon as the back-run is introduced the relation of the blow period to the rest of the cycle is altered, and it is to be expected that blowing conditions will be affected. Indeed, a possible reduction in the time of blowing is one of the direct results of the back-run, and the fact that more downward steam can be used, leading to better conditions in the fire, is another. Dr. Parker suggests the standardization of the carbon dioxide content of the blow gases as one basis of comparison, and other speakers indicate that the time of blowing should be the same; but if such items are to be regarded as fundamental, one can ask, why not standardize the temperature of the blow gases, since an increase in their temperature has the same influence on the generator as a reduction in the carbon dioxide content? Or, to trace a connection back still further, why not liberate the same quantity of heat in the generator per blow? Or, in using back-run steaming, should the sum of the heat liberated by blowing and the heat returned during the back-run be made equal to a constant? It is plain that one is very soon surrounded by a number of incompatible " standard conditions."

Thus the tests were made to represent the results of normal working, and they all have their place in the Report. A point to which special attention is given is the influence of curtailing the use of the back-run by the time allowed for oil injection (Test 1), this connection between carburetting and back-run steaming being one of the features of the process. This test should not be regarded as unsatisfactory. I think the comparison of its results with those of the other back-run, Test 2, is as important as the comparison of Test 2 with the down-run tests. Test 1 shews how the advantages of back-run steaming may be readily lost as a result of factors which may well escape the notice of plant operators who are not using chemical methods of control. The comparison of Tests 3 and 4 shews an unavoidable loss in the efficiency and throughput of a generator operated on the down-run cycle, when the calorific value of the gas made is increased.

Constancy of Working.

Dr. Parker draws attention to the influence of the ash in Test 5 and suggests that the differences between the other tests may be due to effects of ash and clinker in the generator. There is no doubt that this was not the case. I cannot help but think that Dr. Parker bases such an opinion and his other remarks on the probable variation in plant performance on his experience of testing hand-clinkered sets. The self-clinkering plant at Nine Elms was remarkably steady during any one test and during the period preceding it (excepting Test 5). Thus in Test 1, the make of gas during the first four days was 7,425,000 cu.ft., and during the second four days 7,485,000 cu.ft., a variation of less than 1 per cent. Similarly the make during the first three days of Test 3 was 5,565,000 cu.ft., and during the second three days 5,542,000 cu.ft., a variation of less than one-half of 1 per cent. The Venturi air meter indicated the presence of any restriction due to clinker in the fuel bed, and during all tests excepting Test 5 the gauge was steady throughout. The strongest evidence for the regular working conditions is given by the results themselves. It was found that a number of items such as carbon dioxide in blow gas, make of gas per day, temperature of gas leaving the bottom of the generators, and steam lost by condensation, &c., shew a remarkable parallelism and could be explained by the nature of the cycle used. If the conditions in the generator had been influenced to any marked extent by variations in clinker formation, &c., this regularity and connection to the nature of the cycle would not have appeared.

In Test 5, as stated in the Report, the conditions were extraordinary as a result of the nature of the ash of coke from a particular coal. I can assure Dr. Parker that the effects of this ash did not interfere in any way with the immediately preceding Test 4. The behaviour of the coke from the particular coal was well known at Nine Elms, and, for that reason, Test 4 was completed while that coal was still in the retorts. The coke did not arrive at the water gas plant until 12 hours after Test 5 had commenced. Its influence can be seen in the following figures which give the make of gas per day during Tests 4 and 5:

		Make per Day in 1000 C.Ft.
Test 4	1st day	1783
	2nd ,,	1794
	3rd ,,	1795
Test 5	4th day	1601
	5th ,,	1605
	6th ,,	1710

The figures shew the regular working throughout Test 4, in which the daily makes varied by only 0·65 per cent. The reason why the lowest make was recorded on the first day of Test 5, in spite of 12 hours of normal working on that day, was that on the second and third days of Test 5 the accumulating ash was dug out of the water seals by hand.

Influence of Moisture in the Coke.

Dr. Parker also referred to the difference in the moisture contents of the cokes used in Tests 2 and 4; the difference was 3·7 per cent. I do not think that the influence of such a difference would have any measurable influence on the generator. The heat of evaporation of this amount of water is equivalent to only 0·3 per cent. of the heat of the coke supplied. Observation indicates, however, that the heat of evaporation is not obtained from the coke but from the sensible heat of the blow gases. For this reason, moisture in coke has a greater influence on carburetting conditions than on the performance of the generator, but when it is realized that the heat absorbed in evaporating the extra moisture and heating its vapour to carburetting temperatures was equivalent to only 1·6 per cent. of the total heat of the blow gases leaving the generator, it follows that the extra moisture in the coke used did not interfere with the results of Test 4.

Real Efficiency.

In concluding the reply to Dr. Parker's remarks I should like to emphasize again the inadvisability of using figures for the efficiency of gas production to express the advantages of back-run steaming. It is only to be anticipated that the gains of the back-run do not appear in such figures in the calculation of which the value of a unit of heat as steam is taken to be the same as that supplied as coke to the generator. Such efficiency figures do not shew the relative inefficiency of the down-run method of working in which the bulk of the extra heat used in the generator is recovered in the waste heat boiler. This is the reason why the true significance of the results of the tests are not to be found in the figures which Dr. Parker has selected. The important figure is the saving in coke to the generator, and by using back-run steaming the coke consumption was reduced by more than 10 per cent. This is a saving of considerable magnitude in the item which is of main importance to the Gas Engineer, to whom a theoretical thermal efficiency is secondary.

Inter-relation of Factors.

I was interested in **Dr. Pexton**'s analysis of the figures of Tests 2 and 4. He arrives at the conclusion that back-run steaming leads to a saving of 3 lbs. of coke per 1000 cu.ft. of blue gas, whereas the actual results of the test shew a saving of 3·7 lbs. The agreement is good in view of the assumptions made in the calculation. The difference would have been still smaller if Dr. Pexton had taken into account a factor he mentions, namely, the less satisfactory blow conditions in Test 4. I am not quite clear as to why this factor was not included since the longer blow in Test 4 was unavoidable if the throughput of the plant was maintained.

Such calculations as Dr. Pexton puts forward are of value in the proper appreciation of results, but it is important to bear in mind the assumptions which are made when using the figures obtained for comparative purposes. This remark applies particularly to the second calculation on the influence of the generator boiler. It cannot be assumed that the heat absorbed by the boiler is raised with the same efficiency as that for gas-making since, in the absence of the boiler, it is probable that the composition of the blow gases, and hence the efficiency of blowing, would be different. Further, the boiler must be considered as a feature which has made possible the use of the self-clinkering grate and in this way has led to a reduction in the loss of fuel in the ashes. Also it has enabled more recent plants to be auto-

matically operated on shorter cycles, which has again given increased over-all efficiency.

Application of the Theory of Water Gas Production to Brick-lined Generators.

Mr. Shapley comments on the theory of gasification put forward in the Report and asks for a modification of it applicable to existing plants. I take it that "existing plants" refers to brick-lined generators. I have had no direct experience of the operation of brick-lined generators and am unable to supply this information. However it would not be a difficult matter to settle experimentally. In order to do this I would suggest maintaining the blow period at a given proportion of the gas-making cycle and then altering the relative amounts of steam passing upwards and downwards through the fuel bed, simultaneously taking observations of the composition and temperature of the blow gases. In this way the most efficient conditions for a given throughput could be found. I was of the opinion that in hand-clinkered sets the amounts of upward and downward steam were proportioned from the point of view of positioning the clinkering zone, and the experiments may be limited by such considerations. I would refer Mr. Shapley to the remarks made by Dr. King during the course of this discussion. Dr. King mentioned experiments in which he had been successful in preventing clinker formation. There is no doubt that, as Dr. King's figures shew, under such conditions more efficient blowing will be obtained by avoiding the influences of the "channelling" to which hand-clinkered sets are especially liable.

I agree with Mr. Shapley that the effects of the ash in the combustion zone are probably marked. The ash and clinker will act as a "diluent" to the associated carbon and, assuming the ash is maintained in a form such that channelling does not occur, its presence will tend to restrict the attainment of high temperatures.

In answer to the query as to whether the explanations of the conditions existing in the fuel bed have been confirmed—the explanations suggested themselves during the tests, but they could only be made complete by the consideration of the results as a whole after the analysis work, &c., had been finished. The opportunity of confirming the opinions expressed presents itself in the forthcoming tests to be made on the water gas plant at Croydon.

Relation of the Cycle to the Rate of Gas Production.

Mr. Shapley also asks for the factors determining the periods of "blow" and "run." During the tests only small modifications were made to these periods and the experimental conditions in this respect were similar to those normally used at Nine Elms. It can be stated however that on a plant operated with a given blast pressure the length of the blow period is the governing factor determining the make of gas per day. Increasing the relative duration of this period, and simultaneously increasing the rate of steam supply during the run, leads to an increase in the volume of gas made. As explained previously such a procedure will, if carried too far, result in a loss of efficiency. Up to a certain point, however, on a plant equipped with a generator boiler, increasing the make of gas has a beneficial influence on the efficiency, in reducing that proportion of the heat which passes to the boiler.

Additional Data.

I am now able to supply some additional information which was not available in time for insertion in the Report.

The Rational Analyses of the Oils Used.

As stated in the Report the oil used in the down-run tests differed slightly in ultimate analysis and specific gravity from that supplied in the back-run tests. The rational analyses of the oils have now been made according to the method put forward by R. H. Griffith,* and the figures given below were obtained:

—	Gas Oil. Back-Run Tests.	Gas Oil. Down-Run Tests.
Temperature at which 50 per cent. distilled, °C.	288	288
Analysis, per cent. by volume—		
Unsaturated hydrocarbons	4	4
Aromatic "	17	16
Naphthene "	23	22
Paraffin " (diff.)	56	58

The data now available confirm the opinion expressed in the Report, namely, that the differences between the oils were, from the point of view of the tests, negligibly small.

Reactivities of Cokes.

The Report contains the results of two comparable tests, Nos. 1 and 6, which differed only in the nature of the coke used; the cokes were from Durham and Yorkshire coals respectively. The reactivities of these two cokes have been determined and found to be 0·24 (Test 1) and 0·23 (Test 6).* These values are the same, within the limits of experimental error, and explain the similarity in the behaviour of the plant in Tests 1 and 6.

I would like to thank Mr. Cunnold, the Engineer, and his staff for the hospitality that was shown to us at Nine Elms. Especially would I like to express my indebtedness to Mr. W. E. Davies for the help and advice he gave us. Mr. Davies was in direct control of the set during the period of the tests, and the steady plant conditions which enabled us to compare our results so readily were the outcome of his careful supervision.

The Efficiency of Gas Production.

The limitations of the figures given in the 31st Report of the Joint Research Committee for the Efficiency of Gas Production were described in the Report itself, and they have been emphasized in the written Reply to the Discussion. The limitations are dependent upon, not so much the principle upon which the figures were calculated, but rather upon the nature of the plant tested, which included a waste heat boiler. It was found that when the plant efficiencies were expressed in such a way as to give credit for the heat recovered in the boiler, the true efficiency of the gas-making process was masked, since the greater part of heat wasted in gas-making was recovered at the boiler. Efficiencies so expressed were determined more by the efficiency with which the boiler recovered the waste heat than by the efficiency of the generator itself. For this reason, when the results of the tests were discussed in the Report, no attention was paid to the figures given for the Efficiency of Gas Production.

It is now thought that, for a plant equipped with an appliance such as a waste heat boiler, the Efficiency of Gas Production is better shewn by means of two figures, one ignoring and the other taking into account the heat recovered by the appliance. The first of these would then give the efficiency of the main process, whilst comparison of the two would indicate how far this efficiency could be increased by the appliance for waste heat recovery.

In this connection a fundamental difference between two methods of recovering waste heat should be remembered. Examples of the two methods in mind are given by (*a*) a waste heat boiler and (*b*) a recuperator for heating secondary air as, say, on a carbonizing plant. In the first method, viz., by waste heat boiler, the heat recovered is utilized to raise steam, &c., which is used in a process entirely separate and different from the main process in which the waste heat is liberated. Thus on a water gas plant the waste heat boiler recovers, in the form of steam, heat which should if possible have been retained in the generator and used for gas making; whilst on a carbonizing plant the usual function of a waste heat boiler is to raise steam from heat which was generated primarily with the aim of heating retorts. The heat as recovered by the boiler may be valuable. The steam raised may be required in the main process and, if not produced in this way, may necessitate the expenditure of additional fuel in an independent boiler, but it is to be realized that the inclusion of a waste heat boiler in the two plants mentioned does not reduce the amount of coke supplied to the water gas generator in the one case or the amount of coke supplied to the producers in the other. In this respect the recovery of heat by means of a recuperator differs fundamentally from the action of a waste heat boiler. On a carbonizing plant the heat given to secondary air in the recuperators is returned to the combustion flues and benefit is derived from it in the heating of the retorts, and as a result the amount of coke consumed in the producer is reduced. Accordingly, one can say that the influence of a recuperator is to increase the inherent efficiency of the main process, whilst the inclusion of a waste heat boiler in a plant has no influence on its inherent efficiency, but, by superimposing a secondary process, increases the overall efficiency.

Consideration has been paid to the difference between these methods of recovering waste heat so that the reason is plain why, when the efficiency of a plant is expressed by two figures as is proposed, the first figure, representing the inherent efficiency of the main process, will always include

* J.S.C.I., 252T, 48, 1929.

* These figures are expressed in the Key-Cobb scale. *Vide* J.S.C.I., 439T, 444T; 49; 1930.

the performance of appliances such as recuperators but will exclude those appliances typified by the waste heat boiler.

These remarks immediately concern the Back-run Process for the manufacture of water gas. In this process the loss of heat from the plant as blow gas is reduced both by the back-run itself and by the waste heat boiler, but, whereas the heat recovered by the waste heat boiler is obtained in the form of steam, the heat returned to the generator by the back-run is used to increase the inherent efficiency of gas-making. Thus, the action of the back-run is analogous to that of the recuperator on a carbonizing plant. The heat which is returned by the back-run steam was, in the first case, developed in the generator and the result of its return is the same as if this extra heat had remained in the fuel bed during the blow in which it was liberated. From this point of view back-run steaming can be regarded as a means of increasing the efficiency of the blow. It follows that in expressing the inherent efficiency of gas-making by the back-run process, the generator should not be debited with the heat returned by the back-run steam.

The Efficiencies of Carburetted Water Gas Production of the tests of the 31st Report are given below expressed by the method now proposed. The first figure represents the efficiency of gas production when no allowance is made for the heat recovered by the waste heat boiler, whereas allowance is made for this heat in the second figure. To make the figures comparable with one another, in deriving the latter efficiency it was assumed that the waste gases had been completely burnt, the products leaving the boiler at the same temperature as that observed during the test. For purposes of record the second figure is followed by a third and bracketed figure which represents the efficiency of the process including the waste heat boiler, for conditions in which no tertiary air was used. Thus in the bracketed figures allowance is made only for the amount of steam which was actually raised in the tests.

A note must be included here with regard to the steam raised in the generator boiler. The heat used for steam raising in this boiler differs from that recovered by the waste heat boiler in that it is not "waste" heat[1]. The annular boiler absorbs heat which, other conditions remaining the same, could have been used for gas-making. In a generator equipped with an annular boiler, steam raising is inseparable from gas-making and hence the steam must be regarded as a product of the main process and account must be taken of this steam when considering the inherent efficiency of gas production. The heat in the steam raised in the annular boiler bears a similar relationship to the heat in the water gas, as the potential heat of coke bears to the heat of the coal gas in a carbonizing plant.

On this basis the Efficiencies of Gas Production have been calculated according to the expressions given below but first, for the sake of convenience, the various items entering into the expressions will be numbered. The items are:

(1) The potential heat of the purified carburetted water gas.
The potential heat of the carburetted water gas given on page 156 of the 31st Report includes the potential heat of the H_2S produced. The potential heat of the purified gas follows directly from its calorific value given on page 140 of the Report.

(2) The potential heat of the purified blue gas.
This follows from the calorific value of the corresponding gas, also given on page 140 of the Report.

(3) The potential heat of the coke supplied to the generator.

(4) The potential heat of the oil supplied to the carburettor.

(5) The sensible heat of the air to blower.
This item includes the total heat of the water vapour contained by the air.

(6) The total heat of the steam supplied to the set.
The heat given to the back-run steam in passing through the carburettor and superheater was not included.

(7) The total heat of the steam supplied to auxiliary plant.
In calculating those efficiencies in which the steam raised in the waste heat boiler is not included, the consumption of the feed water pump to the boiler was omitted. In the case of the efficiency of blue gas production, steam consumed by such items as the oil pump was not included.

(8) The potential heat of the tar.

(9) The total heat of the steam raised in the generator boiler.

(10) The total heat of the steam raised in the waste heat boiler.
It should be noted that, in the earlier Reports of the Committee, the plant, when not self-supporting in steam, was debited with the heat required as coke to raise the steam (assuming a boiler efficiency of 70 per cent.). The position is now somewhat different. With the general adoption of waste heat boilers, this procedure exaggerates the importance of the unit of heat as steam. For the present purposes and for future work in which self-steaming plants are considered, it appears preferable to use the unit of heat as steam, directly, without regard to the efficiency of its generation.

The Efficiencies of Gas Production are then given by the following equations of which the numbers in brackets are defined and listed above:

A. The Efficiency of Carburetted Water Gas Production, no allowance made for the heat recovered in the waste heat boiler (the inherent efficiency of the carburetted gas process).

$$= \frac{(1)}{[(3) + (4) + (5) + (6) + (7)] - [(8) + (9)]}$$

B. The Efficiency of Carburetted Water Gas Production, allowance made for the heat recovered in the waste heat boiler.

$$= \frac{(1)}{[(3) + (4) + (5) + (6) + (7)] - [(8) + (9) + (10)]}$$

In this expression the influence of incomplete combustion of the waste gas is made apparent in the magnitude of item (10).

C. The Efficiency of Blue Water Gas Production, no allowance made for steam raised in the waste heat boiler (the inherent efficiency of the blue gas process).

$$= \frac{(2)}{[(3) + (5) + (6) + (7)] - [(9)]}$$

In plants not equipped with generator boilers item (9) is zero.

When the plant tested is designed to make carburetted water gas it is difficult to express the Efficiency of Blue Water Gas Production so as to allow for the recovery of waste heat in the waste boiler. If the generator had been installed as a blue water gas plant, and down-run steaming had been used, there would have been no necessity for the presence of the carburettor and superheater, and an additional amount of heat would have become available for steam-raising. From the results of Test 3 it can be estimated that, under such conditions the efficiency of the blue water gas plant, including the waste heat boiler, would have been approximately 70 per cent. if the waste gases had been completely burnt. Also, in the case of a back-run blue gas plant, it is probable that chambers of the capacity of the carburettor and superheater would have been unnecessary for superheating the steam; this could have been done in a rather large combustion chamber at the entrance to the boiler. However, for the purpose of studying the manufacture of carburetted water gas, the efficiencies, obtainable by isolating the generator and waste heat boiler, are not of great importance, since, if the blue gas had not been carburetted, the operation of the generator would have been different. This point has only been mentioned to indicate that the over-all efficiency of gas production on a blue water gas plant, including a waste heat boiler, is not far below the corresponding figures for a carburetted plant, the reason depending on the amount of heat used in the latter plant to maintain the carburettor and superheater at the desired temperatures. As will be seen, however, there is a considerable difference between the efficiencies of blue and carburetted water gas production when the recovery of heat by the waste heat boiler is not taken into account, and the equalization of the efficiencies by equipping the plants with waste heat boilers would, in the case of blue gas, be accompanied by a considerable excess of steam above plant requirements; in the example indicated above, viz., Test 3 of the 31st Report, the heat in the blow gases leaving the generator was sufficient to raise approximately 100 lbs. of steam in the waste-heat boiler.

Back-run steaming is a method of heat recuperation particularly suited to the manufacture of blue water gas, and, in the absence of considerations for carburetting, it should not be difficult to arrange for the superheating of all of the steam supplied. The return of heat to the generator by this means would increase the true efficiency of gas production, and at the same time reduce the excess of steam

[1] It is agreed that in the absence of the boiler the loss of heat from the generator by radiation and convection would be larger and, to the extent to which the boiler reduces this loss, the heat in the steam raised can be regarded as recovered "waste" heat. To be strictly accurate, in calculating comparative figures for the inherent efficiency of gas production, allowance should be made for variations in the loss by radiation and convection brought about by the annular boiler, but in view of the uncertainty of this variation, and also for the sake of simplicity, no such allowance has been made in the present calculations. When the performances of two generators, both equipped with annular boilers, are compared, variations in the heat lost by radiation, &c., become negligible.

raised. A blue gas plant designed in this way, and in which the generator boiler was omitted, should have a high efficiency, the efficiency not depending upon the production of a considerable amount of steam above plant requirements.

The efficiency of Blue Gas Production, making no allowance for the waste heat boiler and calculated according to the expression given above, is of interest in the consideration of a test on a carburetted water gas plant in so far as it indicates the performance of the generator separated from the efficiency of oil cracking. It is moreover the only efficiency figure which is not influenced directly by the amount of oil used. It should be remembered, however, that it is indirectly dependent upon carburetting, since, as described in the Report, the method of operation of the generator was governed by considerations for the oil.

The Table below gives the efficiencies of the tests of the 31st Report, and, in addition, the tests of the 6th, 7th, 10th, and 27th Reports of the Joint Research Committee. All the figures in this Table are calculated using the expressions given above and are comparable excepting in so far as the carburetted gases prepared were of different calorific values, and also when the nature of the influence of the steam raised in the generator boiler on the efficiencies is realized. It must be emphasized that the figures which have been published in the Reports themselves are not all calculated on the same basis and are not comparable. The efficiencies given in Appendix II. of the 31st Report were calculated in such a way that the generator was debited with the steam required for gas-making, and full credit was not made for the steam raised on the plant. On further consideration it is thought that the methods given above are preferable. Also, in earlier Reports the figures include the influence of partial combustion of the waste gases or, in cases when the steam raised was deficient, the additional heat required was taken as the heat of the equivalent amount of coke.

N.B.—The figures in the Table make no allowance for (*a*) the potential heat of ashes and clinker, (*b*) the sensible heat of the carburetted water gas and undecomposed steam leaving the top of the superheater. Some of this heat can be recovered if the condensers on the carburetted gas stream are cooled with boiler-feed water. Heat as warm water is, however, at a low potential and not of great value, also, at Nine Elms, the amount of water used in the condensers was in considerable excess of the water supplied to the boilers on the water gas plant.

The Efficiencies of Gas Production.

Test No.	Calorific Value of C.W.G. B.Th.U. per Cu.Ft.	The Efficiency of C.W.G. Production.		The Efficiency of Blue Water Gas Production. Efficiency C.
		Efficiency A.	Efficiency B.	
31st Report of the Joint Research Committee—				
Test 1, back-run . .	495	64·6	72·6 (68·4)	49·9
Test 2, back-run . .	390	62·8	70·6 (66·4)	56·c
Test 3, down-run . .	491	64·1	72·3 (69·2)	50·6
Test 4, down-run . .	395	59·2	69·2 (64·0)	51·7
Test 5, down-run . .	398	55·8	68·5 (60·0)	48·2
Test 6, back-run . .	493	64·5	73·0 (69·5)	50·4
27th Report of the Joint Research Committee .	503	65·9	74·6 (69 8)	51·0
10th Report of the Gas Investigation Committee—				
Test C				48·4
Test D				51·0
7th Report of the Gas Investigation Committee (average) . . .	483	61·4	72·3 (67·8)*	48·0
6th Report of the Gas Investigation Committee (average) . . .				48·3

* Some tertiary air was used in these tests.

Comparison of the figures given for Tests 2 and 4 of the 31st Report shew that the use of back-run steaming increased the efficiency of the generator by 4·3 per cent. and the efficiency of carburetted gas production by 3·6 per cent. When, however, the performance of the waste heat boiler is included, the latter increase is reduced to 1·4 per cent. for complete combustion of the waste gas or to 2·4 per cent. for conditions in which no tertiary air was used. Comparison of Tests 1 and 3 shews that in Test 1 the gains of the back-run were lost, but methods for avoiding this loss have been given in the Report.

It should be noted that the comparative value of the efficiencies of carburetted water gas production, including the waste heat boiler, depends upon the value given to the excess steam produced above plant requirements. The excess was less when full use was made of back-run steaming.

Effluents and Ammonia

2nd Report of the Sub-Committee

Mr. Alfred L. Holton.

RECOVERY OF PHENOLS AT PARTINGTON.

Working Statement for Thirteen Months ended September 30, 1932.

The removal of the phenols from the liquor has been satisfactory and has reached expectations.

The following alterations have been made to the plant since it was erected (as described in Communication No. 29):

(*a*) In September, 1931, alterations were made to the still column. The solid plate separating the dephlegmator from the main column was removed, thus making the dephlegmator and column one piece of apparatus. This alteration produced a benzole containing less phenol and reduced the pressure thrown by the combined column.

(*b*) In October, 1931, alterations were made in the position of the return pipe from the column to the still; also to the steaming arrangements, giving a crude phenol containing less neutral oils, while at the same time reducing the high-pressure steam consumption.

(*c*) Further improvements in the quality of the crude phenols have been effected by the addition of filtration columns filled with coke and steel turnings for the removal of suspended tarry matter from the raw liquor prior to the liquor heater, approximately one gallon of tar being removed per 1000 gallons of liquor passed through the filter.

On two occasions leaks have developed in the high-pressure steam coil of the large still, causing a temporary disturbance of the usual smooth working. The results of the disturbance are reflected both in the quality of the crude phenols and in the "loss" of benzole occasioned during the stopping and re-starting of the plant (see Table VI.).

An experiment was made in the use of a crude benzole obtained from a benzole extraction plant, by washing coal gas with gas oil. Its use was discontinued owing to the increased content of hydrocarbon oils in the crude phenols. A trial is at present being conducted with the light fraction only of such a crude benzole and the first week's working shews a decided improvement in the recovered phenols, as compared with that produced with ordinary crude benzole.

The use of benzole with a comparatively short distillation range is also found to improve the quality of the crude phenols by avoiding the inclusion of the "tail" of the benzole in the recovered product.

Carbon Filters.

Two types of activated carbon have been in use over the period under review—No. 1 filter containing Hydraffin 11 and No. 2 filter containing Lurgi Ruhr-Kohl. Owing to the difference in the bulk density of the two carbons, No. 1 filter contained one ton, while No. 2 filter held only 14 cwt.

The Ruhr-Kohl is much softer than Hydraffin 11, and some difficulty has been experienced by the powdering of the material and the consequent washing away with the liquor as a fine sludge.

The absorbent capacities of Ruhr-Kohl and Hydraffin 11 are apparently the same, but undoubtedly the latter is the more suitable carbon for the requirements of the present arrangement of the plant, and Hydraffin 11 is now being used to make up the wastage in the filter containing Ruhr-Kohl.

No. 1 filter has worked with uniform satisfaction and so far shews little signs of decreased efficiency. As there is

no evidence of the clogging of the carbon from any source, a life of at least two years may be anticipated.

The quantity of liquor which has passed through the two filters since the plant was brought into operation (August, 1931) is given below:

No. 1 filter	Hydraffin 11	2,759,700 gallons
No. 2 ,,	Ruhr-Kohl	1,998,000 ,,

The treated liquor has contained an average of 0·35 gramme benzole per litre. The inlet liquor contains 0·9-1·00 gramme per litre.

Benzole Loss.

It has always been noted that the main economic consideration of a dephenolating plant of this type is the loss of benzole. The figures given in Table I. shew great variations in benzole losses, and much useful experience has been gained by noting the varying losses over the past year's working. In Table IX. (*a* and *b*) an attempt has been made to apportion the losses. In these Tables no account has been taken of mechanical or accidental losses, which cannot be ascertained, but have now been reduced to a minimum. Vapour losses (" breathing ") have been reduced, as far as possible, by arranging that all gases leaving the plant pass through a scrubber fed with crude phenols, which is afterwards returned to the small still.

The benzole losses have been greater than was at first anticipated, being three times the quantity given in the statement presented at the 3rd Autumn Research Meeting, the data then submitted being based on a run of one month only.

Over the past thirteen months, the plant has worked at a loss of 1·73 gallons of benzole per 1000 gallons of liquor treated. The loss of benzole in the treated liquor has been reasonable averaging 0·4 gallon of benzole per 1000 gallons of liquor treated.

The constant re-distillation of the benzole may give rise to neutral oils and pitch by polymerization at some point during the process; and if such is the case, then a portion of the loss of benzole is accounted for, and the presence of some pitchy matter, &c., in the crude phenols is explained.

The percentage of neutral oils in the crude phenols has been reduced to what now appears to be a minimum, but in the experiment of using crude benzole the neutral oils increased by approximately 100 per cent. The whole of the neutral oils is included in Table VIII. (*a* and *b*).

Attempts have been made to correlate the loss of benzole with the ratio of benzole/liquor, but the information available does not lead to any definite conclusion. Every time either the ratio or the total throughput of liquor and benzole is altered there is some disturbance of the balance, and an apparent alteration in the stock of benzole may take place which usually rights itself after a few days. It is possible that the greater the quantity of benzole in circulation the greater may be the unaccounted-for loss, but there is no direct evidence on this point. When the plant is re-started after a complete stoppage there is usually a comparatively heavy loss of benzole due to some cause at present undetermined.

Since May, 1932, the dephlegmator has been operated so as to give a little phenol in the benzole after distillation, 0·1 gr. C_6H_5OH per litre being arbitrarily fixed as a working basis. It will be seen that the returns from this date shew a marked reduction in the loss of benzole (see Table II.). A special thermostatically controlled valve has now been fixed to give finer control of the dephlegmator, and this side of the problem is being further investigated. The inclusion of some phenol in the benzole lowers somewhat the efficiency of extraction of phenols from the liquor, but the lowering of efficiency can be compensated by raising the ratio of benzole/liquor.

Relation between the Ratio Benzole/Liquor and Percentage Recovery of Phenols.

The percentage recovery of phenols from the liquor varies broadly with the ratio benzole/liquor, and the plant returns shew that with a ratio of 90 per cent., a recovery of 90 per cent. may be expected, with a reduction in the oxygen-absorption figure of about 65 per cent. The percentage recovery appears to vary a little with the throughput of liquor, probably owing to variation in time contact.

The phenol content of the liquor has been fairly constant throughout the period, and such variations as have occurred have made very little, if any, difference to the efficiency of the washing.

Composition of Crude Phenols.

The combined percentage of crude carbolic acid and cresylic acids in the recovered phenols has been fairly constant (about 75 per cent. by volume). It is difficult to correlate the available data with certainty, but it appears probable that the ratio of phenol/cresol in the recovered crude phenol varies as the percentage recovery from the liquor, as indicated in Table V.

Effect of the Process for the Recovery of Ammonium Chloride on the Dephenolating Plant.

The complete plant for the recovery of the ammonium chloride from the first 5 gallons of liquor condensate by circulation in a closed system was put into operation in June, 1932; and since this date the character of the liquor treated by the dephenolating plant has altered somewhat as shewn in Table IV. The liquor is cleaner and gives less trouble on distillation. No lime is being used, and the waste liquor greatly improved in colour.

The combined process gives a 75 per cent. reduction in the oxygen-absorbing bodies entering the sewer.

TABLE I.—*Dephenolating Plant—Complete Returns for the Thirteen Months ended 30th September, 1932.*

Month.	Plant Working. Days.	Plant Stopped. Days.	Liquor Treated. Total Gallons.	Crude Phenols Recovered. Total Gallons.	Crude Phenols Recovered per 10.0 Gallons Liquor.	Benzole "Lost." Total.	Benzole "Lost" per 1000 Gallons Liquor Treated.	Benzole "Lost" per 100 Gallons Crude Phenols Recovered.
1.	2	3	4	5	6	7	8	9
1931.								
September	25½	4½	448,080	1,825	4·07	85	0·19	4·1
October	25⅝	5⅜	411,480	1,960	4·76	416	1·01	21·2
November	29	1	537,800	3,029	5·63	1,629	3·03	53·8
December	25 11/16	5 5/16	468,976	2,564	5·47	933	1·99	36·4
1932.								
January	31	0	414,334	2,158	5·16	890	2·15	41·6
February	29	0	483,758	2,534	5·24	1,082	2·24	42·7
March	19⅛	11⅞	351,902	1,638	4·65	908	2·58	55·4
April	23½	6½	283,420	1,389	4·90	1,076	3·80	77·5
May	31	0	318,720	1,438	4·51	Cr. 122	Cr. 0·38	Cr. 8·5
June	22¾	7¼	211,440	1,145	5·42	408	1·93	35·6
July	29 7/12	1 5/12	284,828	1,435	5·04	354	1·24	24·7
August	24 13/16	6 3/16	241,981	1,092	4·51	818	3·38	74·9
September	30	0	310,790	1,499	4·82	360	1·16	24·0
Totals	346⅔	49⅓	4,767,509	23,686	4·97	8,837	1·85	37·3

TABLE II.—*Dephenolating Plant—Data Over Periods of Normal Working.*

Date, 1931–1932.	Days.	Liquor Treated. Gallons.		Benzole Circulated. Gallons.		Ratio Benzole Liquor. Per Cent.	Crude Phenols Recovered. Gallons.		Crude Phenols Recovered per 1000 Gallons Liquor.
		Total.	Per Day.	Total.	Per Day.		Total.	Per Day.	
1	2	3	4	5	6	7	8	9	10
Sept. 1 . . . Sept. 25 . . .	25	431,280	17,251	(388,152)	(15,526)	(90)	1,825	73	4·23
Oct. 2 . . . Oct. 24 . . .	24	399,480	16,645	(359,532)	(14,981)	(90)	1,960	82	4·91
Nov. 3 . . . Dec. 9 . . .	37	695,800	18,805	(626,220)	(16,925)	(90)	4,074	110	5·84
Dec. 15 . . . March 8 . . .	85	1,368,556	16,100	1,042,700	12,267	76·2	6,733	79	4·92
March 22 . . . April 6 . . .	16	232,368	14,523	180,240	11,265	77·6	1,420	88	6·10
April 14 . . . June 12 . . .	60	609,480	10,158	531,168	8,853	87·2	2,981	50	4·89
June 22 . . . Aug. 22 . . .	62	574,364	9,264	468,672	7,559	81·4	2,967	48	5·17
Sept. 8 . . . Sept. 30 . . .	23	238,190	10,356	210,008	9,131	88·2	1,139	50	4·78
Totals . . .	332	4,549,518	13,703	3,806,692	11,466	83·7	23,099	69·6	5·08

NOTE.—Figures in brackets are estimated only.

TABLE II.—*Continued.*

Date, 1931–1932.	Benzole "Lost" (Used).		Benzole "Lost."		Phenols in Liquor Gms. per Litre.				Oxygen Absorption, 4 Hours at 27° C.		
	Total.	Per Day.	Per 1000 Gallons Liquor.	Per 100 Gallons Crude Phenol.	Raw.	Dephen.	Reduction	Reduction. Per Cent	Raw.	Dephen.	Reduction. Per Cent
	11	12	13	14	15	16	17	18	19	20	21
Sept. 1 . . . Sept. 25 . . .	625	25	1·45	34·3	4·79	0·71	4·08	85·2	1313	543	58·6
Oct. 2 . . . Oct. 24 . . .	334	14	0·84	17·0	4·66	0·40	4·26	91·4	1396	474	66·0
Nov. 3 . . . Dec. 9 . . .	1582	43	2·27	38·8	4·28	0·29	3·99	93·2	1110	411	63·0
Dec. 15 . . . March 8 . . .	2454	29	1·79	36·4	4·65	0·63	4·02	86·5	1200	405	66·2
March 22 . . . April 6 . . .	782	49	3·37	55·1*	4·57	0·71	3·86	84·5	1182	507	57·1
April 14 . . . June 12 . . .	900	15	1·48	30·2†	4·37	0·51	3·86	88·3	1087	374	65·6
June 22 . . . Aug. 22 . . .	880	14	1·53	29·7	4·66	0·89	3·77	80·9	1050	419	60·1
Sept. 8 . . . Sept. 30 . . .	310	13½	1·30	27·2	4·50	0·76	3·74	83·1	1100	450	59·1
Totals . . .	7867	23·7	1·73	34·1	4·56	0·62	3·94	86·4	1157	426	63·2

* Crude benzole in use. † Phenol introduced into benzole during this period.

TABLE III.—*Dates and Reasons for Plant Closing Down*

Month.	Days.	Hours.	Reason.
1931.			
September . .	4	12	Alterations to column, &c.
October . . .	5	21	Alterations to return pipe from column to still; and to steam inlet
November . .	1	0	
December . .	5	1½	Emptying and refilling No. 2 filter, installing flow controller, &c. Shortage of liquor (1 day)
1932.			
January . . .	*Nil*		..
February . .	*Nil*		..
March . . .	11	21	Leak in high-pressure steam coil of large still
April . . .	6	4	Shortage of liquor
May	*Nil*		..
June	7	6	Shortage of liquor
July	1	10	Shortage of liquor
August . . .	6	4½	Leak in high-pressure steam coil of large still
September . .	*Nil*		..
	49	8	

Plant working 346⅝ days in 396 days = 87·5 per cent.

TABLE IV.—*Typical Analyses Before and After Separation of Liquor for Ammonium Chloride Manufacture.*

—	Before.		After.	
	Gms. per 100 c.c.	O/A Parts per 100,000.	Gms. per 100 c.c.	O/A Parts per 100,000.
1	2	3	4	5
Ammonia Free	0·61	..	0·68	..
Fixed	0·49	..	0·14	..
Total	1·10	..	0·82	..
Sulphide (as H_2S)	0·0174	..	0·050	..
Thiosulphates (as S)	0·0194	17	0·040	32
Thiocyanates (as CNS)	0·020	17	0·054	45
Ferrocyanides	Traces	..	..	..
Phenols (as C_6H_5OH)	0·470	837	0·460	819
Oxygen absorbed (4 hrs. at 270° C.) . (due to higher tar acids)	..	494	..	194
Oxygen absorbed (total) found .		1365		1090

TABLE V.—*Ratio of Carbolic/Cresylic in Crude Phenols Produced.*

Percentage Recovery of Crude Phenols.	Percentage by Volume.		Ratio Carbolic : Cresylic.
	60's Crude Carbolic Acid. (As Tested.)	Cresylic Acid. (As Tested.)	
1	2	3	4
80	61·2	17·5	3·5 : 1
85	63·2	13·7	4·6 : 1
91	69·7	7·6	9·1 : 1
81	60·7	18·8	3·2 : 1

TABLE VI.—*Details of Omitted Periods.*

Dates (Inclusive).	Liquor Through Plant. Gallons.	Crude Phenols Recovered. Gallons.	Benzole "Loss." Gallons.	Period. Days.	Remarks.
1	2	3	4	5	6
1931.					
Sept. 26—Oct. 1	26,800	0	0	6	
Oct. 26—Nov. 2	14,800	0	Cr. 26	8	
Dec. 10—Dec. 14	12,000	50	155	5	See note (*a*)
1932.					
March 9—March 21	22,126	24	225	13	See note (*b*)
April 7—April 13	22,780	125	36	7	
June 13—June 21	19,200	132	0	9	
Aug. 23—Sept. 7	100,285	256	580	16	See note (*c*)
Totals	217,991	587	970	64	

NOTES.—(*a*) The plant was shut down during this period for emptying and re-filling filter and installing flow meter.
(*b*) Plant shut down for repairs to high-pressure steam coil of large still—still emptied.
(*c*) Plant shut down for repairs to high-pressure steam coil of large still—still emptied. Considerable fluctuation of stock of benzole and make of crude phenols took place for some 6 days after re-starting. It was also found necessary to re-distil the stock of crude phenols.

TABLE VII.—*Particulars of Liquor Treated, &c.*

—	Liquor Treated. Gallons.	Crude Phenols Recovered.	Benzole "Lost."
1	2	3	4
Total from Table II.	4,549,518	23,099	7867
Total from Table VI.	217,991	587	970
Totals	4,767,509	23,686	8837
Totals from Table I.	4,767,509	23,686	8837

TABLE VIII. (A).—*Average Analysis of Crude Phenols.*

[Based on Table I.]

Analysis.	Percentage.	Representing on the Total Make of 23,686 Gallons. Gallons.
1	2	3
Crude carbolic acid (60's)	61·9	14,662
Crude cresylic acid	13·1	3,103
Higher tar acids	9·3	2,203
Water	0·4	95
Total hydrocarbons (neutral oils)	7·5	1,776
Pitch residue, &c.	7·7	1,824
Totals	99·9	23,663

TABLE VIII. (B).—*Average Analysis of Crude Phenols*

[Based on Table II.]

Analysis.	Percentage.	Representing on the Total Make of 23,099 Gallons. Gallons.
1	2	3
Crude carbolic acid (60's)	61·9	14,298
Crude cresylic acid	13·1	3,026
Higher tar acids	9·3	2,148
Water	0·4	92
Total hydrocarbons (neutral oils)	7·5	1,732
Pitch residue, &c.	7·7	1,779
Totals	99·9	23,075

It should be noted that the figures given are averages of many tests made during the period under review.

TABLE IX. (A).—*Benzole Losses.*

[Based on Table I.]

Source.	Quantity (Gallons).
From benzole remaining in dephenolated liquor (4,767,509 gallons at 0·35 gram per litre)	1907
From neutral oils in crude phenols. (Table VIII. (A).)	1776
From pitch, &c., in crude phenols. (Table VIII. (A).)	1824
"Unaccounted-for"	3330
Total benzole loss	8837

TABLE IX. (B.)

[Based on Table II.]

Source.	Quantity (Gallons).
From benzole remaining in dephenolated liquor (4,549,518 gallons at 0·35 gram per litre)	1809
From neutral oils in crude phenols. (Table VIII. (B).)	1732
From pitch, &c , in crude phenols. (Table VIII. (B).)	1779
"Unaccounted-for"	2547
Total benzole loss	7867

TABLE X.—*Extra Costs Incurred at the Partington Works in Respect of Working the Dephenolating Plant for the Thirteen Months ended 30th Sept., 1932.*

[Liquor treated during period, 4,767,509 gallons.]

Expenditure.	£	s.	d.
Capital Charges (Interest and Sinking Fund Charges)—			
Foundations and building, £2900 at 6½ per cent. (30 years)	204	4	2
Plant, &c., £4900 at 8 per cent. (20 years)	424	13	4
Running Costs—			
Live steam, 3867 tons at 2s. per ton	386	14	0
Exhaust steam, 3777 tons	..	..	..
Benzole, 8837 gallons at 1s. 6d. per gallon	662	15	6
Activated carbon, 1 cwt. 3 qrs. 4 lbs. at £130 per ton	11	12	2
Repairs (mainly cost of repairing stills) (See Table III.)	60	0	0
Labour (youth, 2 hours per day for cleaning purposes)	25	4	0
	£1775	3	2
As an offset against the foregoing expenditure, there is the income derived from the recovered phenols—viz., 23,686 gallons at 1s. per gallon	1184	6	0
	£590	17	2

£590 17s. 2d. ÷ 4,767,509 = 2s. 5·7d. per 1000 gallons of liquor treated.

NOTES.—(*a*) The total benzole "lost" over the whole period—*i.e.*, including abnormal working, has been charged (as per Table I.).
(*b*) Until recently, the required benzole has been purchased from outside sources. The Gas Department is now producing benzole, and this will result in a saving on this item.
(*c*) The cost of activated carbon and repairs during the period may be increased in future periods, but not to any great extent.

Dr. Key's Reply.

Dr. KEY, in reply to the discussion, writes:

In the course of his comments on the Report **Mr. A. L. Holton** says it is reasonable to assume that since the oxygen absorption figure of the gas-works effluent is 50 to 100 times greater than that of sewage, the cost of purification will rise in proportion. This is not necessarily the case, as was stated in the Report, and as was further emphasized by Mr. O'Shaughnessy.

A further statement of Mr. Holton is to a great degree contrary to the opinion expressed by the Liquor Effluents and Ammonia Sub-Committee, which is again supported by Mr. O'Shaughnessy. Mr. Holton says, "The proper place for the total or partial treatment of liquor effluent is the Gas Works." Mr. O'Shaughnessy says, "In general the most economical method of disposal of the waste liquors from Gas Works is their adequate dilution and proper handling at the sewage disposal works."

Mr. Holton's written contribution to the discussion on the operation of the dephenolating plant at Partington is a complete Paper in itself, and contains information which should be of great value to the Industry.

In the course of the account it is stated that the percentage recovery of phenols from the liquor varies broadly with the ratio of benzole to liquor. The Tables given, however, indicate that this is so only to a very slight degree. In the First Report of the Liquor Effluents and Ammonia Sub-Committee it was concluded that this ratio is only a minor factor in the efficiency of washing, provided that the amount of solvent exceeds a certain minimum.

It is to be expected that an increase in washing efficiency would result in an increase in the ratio of phenols to cresols

in the recovered product, but the differences shewn in Table V. of Mr. Holton's contribution are far too great to be accounted for by this factor alone. Nothing short of a substantial alteration in the composition of the liquor would result in such a variation.

The most interesting part of the contribution relates to the benzole lost in the process. The losses are set out in Table IX. In this connection it should be pointed out that neither the whole of the neutral oils nor the whole of the pitch in the crude phenols have their origin in the benzole used, since they are contained to some small extent in the raw liquor itself, and would be extracted from it by the benzole, ultimately reappearing in the recovered phenols. The two items of benzole loss corresponding to neutral oils and pitch in the phenols may therefore be too high, making the unaccounted for loss too low. Even as set forth at present this item is by far the largest single source of loss. Further work on this point is therefore urgently needed. I would like to suggest that part of the " unaccounted for " item is caused by too low a value being taken for the benzole content of the dephenolated liquor. Determinations carried out by myself on samples of liquor with which Mr. Holton kindly supplied me, have given considerably higher results.

The trial using crude benzoles gave a very disappointing result, but the subject is well worth further investigation, since it is an obvious method of cheapening very considerably the whole process.

Underground Gases

Dr. J. S. Haldane's Reply.

The cases described by **Mr. Lacey** and **Mr. Hollings** add greatly to information on the subject of the Report. Although the analyses quoted by Mr. Hollings point on the whole to fermentation gas, certain features of them and particularly the apparent presence of unsaturated hydrocarbons, seem also to point to admixture of coal-gas. The method of analysis is not stated, but if it was carried out by absorbents, I should like to point out that when, as in this case, much methane is present, an error is liable to occur owing to the solubility of methane in the various absorbent liquids, so that an erroneous estimate for both unsaturated hydrocarbons and carbon monoxide is possible.

I am very glad that Mr. Hollings has placed on definite record the results of the very significant experiments made in his laboratory on the anaerobic fermentation of earth taken from beneath the site of the Holborn Tube and showing that hydrogen, not methane, was formed in this case, owing, perhaps, to the reaction of the earth.

I entirely agree with **Dr. Lessing** as to the frequent influence of iron compounds in the formation of blackdamp, and I should like to testify to the skill and pluck of his assistant Dr. Winterbottom in obtaining satisfactory gas-samples after the accident at Dagenham.

With regard to the question whether the presence of carbon monoxide affords satisfactory evidence of gas escapes, there is no doubt now that small proportions of carbon monoxide may be formed in the oxidation at low temperatures of various other substances besides the case, mentioned in my Report, of coal. There must, therefore, be a fair and undoubted proportion present (0·2 per cent. or more) to make contamination with coal-gas certain.

Conversion of the Potential Energy of Coal Gas into Radiant Energy

Professor W. T. David.

Professor W. T. DAVID, Sc.D., M.Inst.C.E. (Professor of Engineering, Leeds University), writes:

The able Report which Dr. Hartley presents has clearly involved a great amount of work and the information it offers is of the greatest interest and usefulness.

A matter dealt with in the Report which has been interesting me very much recently is the amount of radiation emitted by the visible (open) flame, including the interconal gases. An examination of the results of some of my early experiments on radiation in gaseous explosions (which Dr. Hartley quotes) suggested that this radiation cannot amount to anything like the 15 per cent. or so of the heat of combustion which flame radiation measurements shew. Dr. Hartley's experiments shew that it is only about one-seventh of the measured amount, which is 15 per cent.

Our radiation experiments have lately been extended to the pre-pressure period in explosions, and they confirm that Dr. Hartley's estimate is of the right order. This matter is of great importance in the calculation of flame temperature, as is so clearly pointed out in the Report.

Dr. Hartley states that his experience suggests that the radiation from flames is mainly of thermal origin. This is a view I have always held as a result of explosion experiments and I believe it to be equally applicable to that part of the radiation which comes from the visible flame and inter-conal gases. But in view of quite recent experiments carried out in conjunction with one of my pupils and now in the press, I feel inclined to go further and to suggest that the radiation resulting directly from chemical activity in flames is negligible. I do not deny that there is chemiluminescence; my suggestion is that upon an energy basis it is negligible in comparison with the thermal radiation. This suggestion is based partly upon the experimental results we have very recently obtained that in a very rapid explosion, such as that of a 30 per cent. hydrogen-air mixture, the radiation emitted during the explosion period, during which the bulk of chemical activity takes place, is very small—certainly less than one-tenth of 1 per cent. of the heat of combustion.

I have read with appreciation what Dr. Hartley has written with regard to flame temperatures, and in this connection I should like to know whether he has compared Loomis and Perrott's results with the calculated values for other air/gas ratios than those given on p. 13. I am not quite clear what specific heat values Dr. Hartley uses, but if they are comparable with those given by Partington and Shilling I think he will find a wide departure between the Loomis and Perrott results and the calculated values, particularly for large air/gas ratios.

If Dr. Hartley collected sufficient data during the tests summarized in Figure 18, it would, I think, be particularly interesting to prepare heat balances based upon the percentage heat given out by the fire and the percentage heat in the leaving gases as calculated from the thermo-couple measurements.

Professor W. E. Garner.

Professor W. E. GARNER, D.Sc. (Professor of Physical Chemistry, Bristol University), writes:

The occurrence of a maximum in the emission of radiation at 2·3μ from coated rods heated in a Méker burner is of very considerable practical and theoretical interest. The intensity of the emission at this wave length varies within wide limits for the different coatings employed, whereas the intensity at 4·4μ is practically constant (Figures 10-16). The maximum at 2·3μ is not the ordinary maximum found for black body emission ($\lambda_{max.}$) since the temperature calculated from it by the equation, $T = 2885/\lambda_{max.}$ micron degrees, is much lower than the values of the temperature found in Table III. Also, since the wave length is independent of the material of which the rods are constructed (except for vitreosil rods), it cannot be a specific emission from the coatings of the rods. There remains only some specific emission of the gas as the cause of the maximum. None of the fundamental vibration frequencies of the carbon dioxide molecule, which gives bands at 4·25, 4·64, and 14·7μ, nor the combination which gives rise to emission at 2·8μ appears to be responsible for the wave length. There is, however, an adsorption band of carbon monoxide at 2·3μ, so that it is a possibility that the emission in question may have its origin in molecules of carbon monoxide which have been made active by collision in the flame. These may give up their internal energy on collision with the heated surface. The experiments of Dixon and Smithells with the cyanogen flame gave us an indication of the presence of nascent carbon monoxide in flames. Per-

haps the maximum which occurs at 2·3μ is to be taken as an additional pointer in this direction.

This hypothesis could be easily tested by varying the position of the rod in the flame or by studying the emission from a rod just above the flame. Since the carbon monoxide content of the flame decreases with the distance from the nozzle of the burner, the relative intensity of the maximum at 2·3μ should decrease as the rod is raised. I should like to ask Dr. Hartley if he has made any measurements of this kind.

Dr. Hartley's Reply.

Dr. HARTLEY, in reply, writes:

Little has been said in criticism, and the appended notes have been made for the most part by way of comment on the remarks of the speakers as enumerated. In preparing the Report I avoided as far as possible reference to appliances made for sale, and I have not discussed any statement that has a direct bearing on proprietary apparatus.

Professor W. A. Bone.—We have measured the energy actually dissipated by the flame as radiant energy, and the experiments do not of themselves permit of an expression of opinion as to stages which may precede the attainment of the state in which the molecules emit the infra-red energy. It was realized, however, that we were possibly measuring only a resultant effect, and I am particularly indebted to Professor Bone for the clear exposition of his views, which adds materially to the value of the Report. The conception which he has advanced appears to provide the necessary link harmonizing the apparent discrepancies in some of the work which has been quoted.

In the discussion of the question of the temperature of the inter-conal gases the phrase was used advisedly that the calculated temperatures may represent the thermal intensity embracing " the energy of rotation, vibration, and ionization for the molecules leaving the inner cone," attention having previously been called to the self-evident fact that the electronic disturbances which cause the emission of visible energy subside rapidly.

I am obliged to Professor Bone for drawing my attention to the inadvertent misquoting of one of Professor David's results. The necessary correction will be made in the Report before it is published in the Transactions.

The phrase " a stationary explosion wave " is really a perpetuation of le Chatelier's term " onde explosive," and was not employed with any special significance.

Dr. E. W. Smith.—Although it is now many years since Dr. Smith carried out experiments on the gas fire, the work which he did in Professor Bone's laboratory in the first decade of the present century has provided an important part of the foundation on which subsequent developments have been based. The compliment which he has paid Radiation Limited is much appreciated, and I can assure him that the Company welcomes an opportunity, such as the present, to place before the Industry the results of its research work, and to participate in technical discussions which do not deal directly with any commercial appliance.

Mr. C. A. Masterman.—The subject of gas fire design *per se* was not under consideration, and questions of heat conservation do not come within the scope of the Report.

We first examined the effect of a copper oxide coating in 1912, some short time after the publication of the Report to which this speaker referred. We were not able to effect an increase in the radiant efficiency by employing such a coating. Our later experience confirmed the earlier results. It will be seen from the curves of Figure 17 that the variation in efficiency resulting from the use of coating substances depends upon the behaviour of the original material of the radiant. Obviously, if our original material had been as B in Figure 17, increases in efficiency would have been recorded with each of the other substances employed. This may explain the differences in the magnitudes of the gains recorded by Kurakawa and ourselves.

The question of luminous flames was not discussed as it was felt better to deal fully with the subject in connection with the Bunsen type flame. This is indicated at the beginning of the Report. Had we included our work on luminous flames it would have made the Communication unwieldy.

Experiments have been made in the United States by Chamberlin and others on the behaviour of the tips of flames, but so far as I am aware no reference has previously been made in the literature to the wavy form which may be assumed by the outer sheath of the Bunsen flame.

The differences between the transfer of energy from a flame to a rod and from a flame to a surrounding mantle such as a radiant are discussed in the Report, and within the limits of a reply of the present nature it is not possible usefully to add to what has been said.

Mr H. J. Hodsman.—If Mr. Hodsman will refer again to the concluding portion of Part I. of the Report he will find the explanation of the apparent differences to which he draws attention. So far as our observations went, no rapid increase in the rate of emission of radiant energy was detected in the vicinity of the outer flame sheath. In view of the fact referred to in footnote 17, p. 22, it will be seen there is no essential difference between the statements which he quotes.

The variation with aeration in the percentage of energy radiated by a Bunsen flame as shewn in Figure 6 would not appear to be in disagreement with our view as to the emission of infra-red energy by the products of combustion. Starting with a highly aerated flame, the first effect of a decrease in aeration is to cause a lengthening of the flame. The volume of heated products radiating is thereby increased, although the average temperature of the heated products may be lower. The curves of Figure 6 represent the resultant of a combination of factors.

Whilst holding no brief for the accuracy of the Helmholtz experiments, the criticism by Messrs. Haslam, Hunneman, and Lovell does not appear to the present writer to be fatal. It will be remembered that the results of our analyses of the radiation from the inter-conal and extra-conal gases are also in keeping with the view that the infra-red energy emanates from the products of combustion themselves.

Professor Garner's results, quoted in the Report, and to which some of the speakers referred, do not appear capable of such obvious explanation. They may be due to variation in the mode of degradation of the energy generated on combustion, an effect which would appear in keeping with the view expounded by Professor Bone. Alternatively, it may be that Professor Garner's results represent an effect due to the influence of the added hydrogen on the ionization of the gases.

Professor Callendar, in his measurements of the radiation from a Meker flame, appears to have assumed uniform spherical distribution. Our experience with the radiation from flames is in general agreement with this. In this connection I would refer to footnote 19, p. 24.

Mr. J. W. Wood.—The question put by this speaker in regard to the fit of flames to the radiant was also raised by Mr. Masterman. The factors which determine the efficiency of conversion of the heat of combustion into radiant energy are enumerated in the Report. Variation in the diameter of the teat orifice with a given radiant will tend to vary the ratio of secondary-air to gas burned. There will probably be an optimum size of teat orifice for a given consumption and aeration; increase in the teat size beyond the optimum figure will probably lead to a decrease in efficiency due to less satisfactory combustion, whilst decrease in the size of the teat orifice will probably lead to a decrease in efficiency consequent upon an increase in the relative amount of secondary-air flowing through the system. The magnitude of the variations will depend much on the radiant design. The discussion in Part III., Section VI., of the Report has a bearing on this matter.

The only calculations in which complete combustion of the gas is assumed are those relating to the radiation from the freely burning flame. This assumption is justified in view of the experience of Mr. H. Davies and the present writer when examining the question of CO production by freely burning flames. (J.S.C.I., Volume 46, No. 22, 1927.)

In Part II., Section IV., dealing with the experiments with the coated rods, it is stated that the layers of the coating material were about 1/64 in. thick. We have found such a layer adequate to produce a marked effect, although, as indicated in the report, it seems probable the radiation from such a layer is by no means saturated.

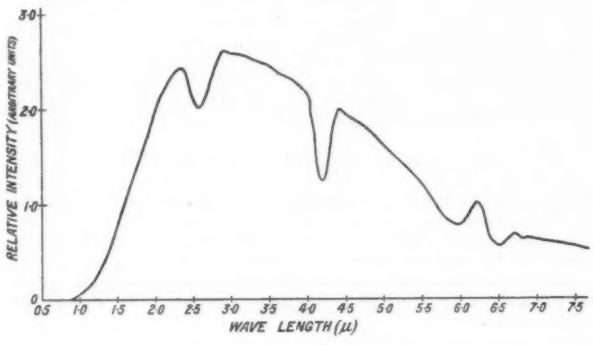
Mr. W. E. Benton.—The wavy form of the Bunsen flame shewn in Figure 1 seems in keeping with the usual instability which characterizes flowing streams of fluid under certain conditions.

The computation which Mr. Benton has made in connection with Figure 7 appears based on an incorrect premise. He would seem to have overlooked, since he does not mention it, the influence on the centre portion of the curves of the radiation from the extra-conal region. This is superimposed on the inter-conal radiation in the case of the zone considered, namely the visible width. It seems merely a coincidence if the formula fits the experimental data, although in any case such agreement should not be regarded as significant, for no doubt other equations could be given quite arbitrarily which would fit the central portion of the curves reasonably well. The most that can be said is that any one set of results is in agreement with homogeneous conditions within the inter-conal region. At no level, however, are the extra-conal gases uniformly radiating. Further, it would seem that the algebraic expression quoted does not take account correctly of the fact that the source which is being considered, the visible width, has a finite diameter.

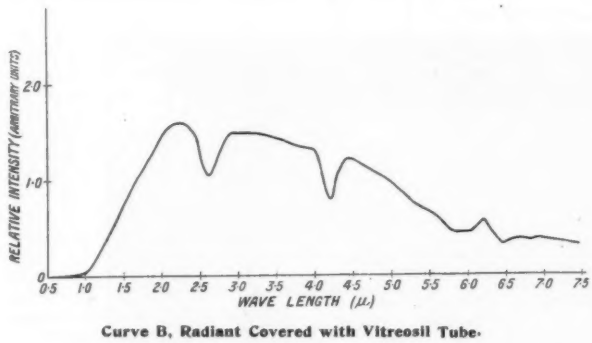
With regard to the curves of Figures 10 to 16, even had the dispersion correction been applied the results would probably still not be quantitative. It must not be overlooked that it would be necessary also to make a correction for the variation in the reflecting power of the mirrors of the instrument with change in wave-length of the reflected energy; there is a triple reflection in the Hilger instrument. This consideration led us to decide that it would be preferable to publish the results as recorded, and to give the details of the spectrometer (footnote 22).

The substances referred to in Table III. were selected as shewing not only that considerable variation could be effected by change in the rod coating, but also to bring out the fact that small traces of impurity might have a predominating influence on the result attained. This, I think, is apparent if the Report is studied. I have seen no published results dealing with the radiating properties of different substances when heated by coal-gas flames, but it will be admitted by any who have actually worked on the subject, that in the present state of knowledge the choice of substance can, unfortunately, only be made at random. Our search has, however, been fairly systematic.

Dr. Burrows Moore.—It is shewn in Table III. and Figure 10 that if it be desired to attain short infra-red energy from coal-gas flames Vitreosil is not a suitable material to use as an emittor, and Dr. Moore does not recommend the substance for this purpose, but rather as an additional filter.



Curve A. Bare Radiant.



Curve B. Radiant Covered with Vitreosil Tube.

The Curves presented by this speaker shew that the substance he used is absorbent over the whole range examined, although somewhat more absorbent in the range 2·2μ upwards than for shorter wave-lengths. The absence of clearly defined selective absorption bands in the second curve suggests there was an appreciable amount of secondary radiation from the Vitreosil itself, due to rise of temperature consequent upon absorption of energy radiated by the main emittor.

The question of the use of radiant energy filters or other adjuncts is outside the scope of the present Communication, and the subject is too wide for adequate discussion in this reply. We have experimented with fused silica and other filters. When filters are used it is desirable they shall not become secondary emittors of long infra red energy. Such an effect can best be avoided by placing them at a good distance from the main emittor. A sheet of transparent fused silica $\frac{1}{8}$ in. thick absorbs about 50 per cent. of the energy from a "Beam" rod heated as in the experiments summarized in Table III., and some 40 per cent. of the energy when the emittor is a "Beam" rod coated with the material referred to as N.160. The absorptive capacity of such filters precludes their adoption in the case of apparatus which depends for its success on high radiant efficiency, although, of course, filters are sometimes used in conjunction with apparatus designed for therapeutic purposes. Coblentz during the last 25 years has published infra-red transmission curves for quartz.

Mr. L. H. Sensicle.—Our curves for the transmission of infra-red energy by skin and horn were re-published in 1931. They have in general been confirmed also by Dr. Taylor working in Sir Leonard Hill's laboratory. Mr. Sensicle appears to have examined somewhat casually the spectral curves given in the Report. He refers to emission maxima at 2·8μ and 4·45μ, whilst the only substance of those given showing an emission at 2·8μ is vitreosil. The 4·45μ band is one of those characteristic of the flame itself.

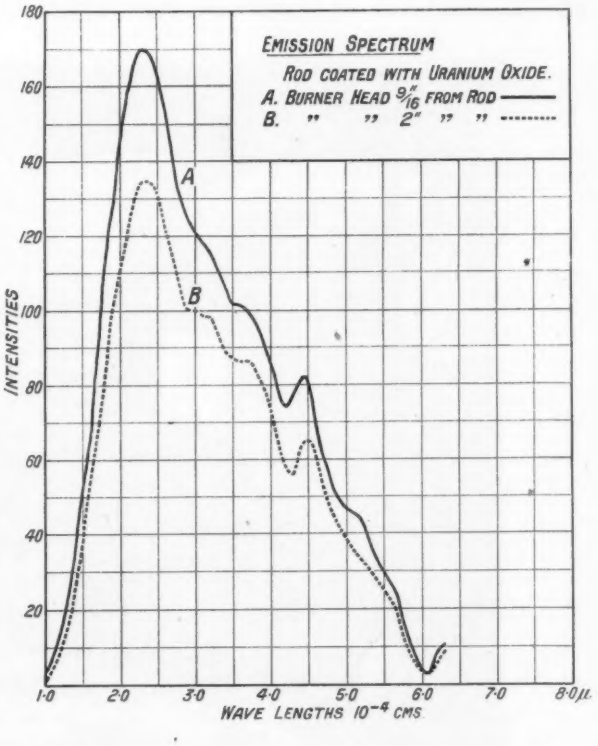
We showed in one of our earlier publications that the moisture content of the skin and sensations of comfort under the influence of radiant heat are intimately connected.

Professor W. T. David.—The results attained by Professor David, which we quoted in Table II., suggest that the infra-red emission by the visible part of a flame will be a small proportion of the total energy radiated. They suggest also that the products from a flame may be responsible for a large proportion of the infra-red energy which is dissipated, a view which later we were able to confirm experimentally. I am glad to learn that Professor David's further work confirms our estimate of the relative magnitudes of the emission by the inter-conal and extra-conal gases of the Méker flame.

The calculations given in the Report are the only two I have made in connection with the Loomis and Perrott results. The air/gas ratios were chosen quite at random. The specific heats employed were taken from Spier's "Technical Data on Fuel," Third Edition, as indicated in the last footnote of the Report. Apparently only the hydrogen values are those of Partington and Shilling.

No measurement of the total flow of gases away from the radiants was made in connection with the curves given in Figure 18, and it is indicated that the CO/CO_2 ratios are really only qualitative.

Professor W. E. Garner.—The fact that the maxima of emission occur at about 2·3μ for the majority of the substances for which emission spectra are given in the Report is in part accidental. Application of the dispersion correction affects some of the curves to slightly different extents and causes relative shifts in the maxima. I doubt very much whether a specific emission by the gas is a cause of these maxima. Since receiving Professor Garner's communication I have had an experiment made in accordance



with the suggestion in his concluding paragraph. Curves shewing the experimental results attained are appended, and it will be seen that the fall in the maximum emission at 2·3μ is part of a fall in the general emission. At the same time I am not sure that the experiment does really test the hypothesis advanced by Professor Garner. There

is a relatively small change in temperature in the interconal gases on moving away from the burner head, and any drop in emission by CO molecules would be more or less in keeping with the drop in emission from CO_2 molecules. In the experiment which we have made the upper curve was attained with the rod at a distance of $\frac{5}{16}$th in., and the lower curve with the rod at a distance of 2 in. from the burner head. When the rod was taken further away from the burner the instability of the flame interfered with the observations.

[The remaining contributions and replies will be reproduced next week.]

IN CONTINENTAL COUNTRIES - - -

Abstract Translations from the Technical Press of France and Germany.

GASIFICATION OF SMALL COKE IN BUILT-IN PRODUCERS.

The subject of producer gas manufacture in gas-works is discussed by E. Dubois and J. Schmid in "Das Gas- und Wasserfach," 1932, 75, 921-926 (Nov. 19).

At the Baden Gas-Works it has been possible, for some years past, to work the producers exclusively on fine coke with the dust screened out; the size ranges from 0·2 to 1 in. and the fuel consists of 82% of 0·6-1 in. material and 18% of 0·2-0·6 in. material. The mixture contains 7·6% moisture and 9·2% ash.

Water is sprayed on to the bars of the step-grate only immediately after clinkering and amounts to 8·7% on the weight of coke gasified. Thereby the grate is kept cool and clean, no dripping occurs, and the clinker is discharged dry. The steam admitted amounts to 31·3% on the weight of coke handled.

The composition of the producer gas is as follows:

—	CO_2.	H_2.	CO.	N_2.	H_2O [Grains /100 C.Ft].
Average	4·9%	11·3%	25·3%	58·5%	1180
After clinkering .	8·1 ,,	8·6 ,,	20·0 ,,	63·3 ,,	1335
Before ,, .	4·2 ,,	12·0 ,,	26·0 ,,	57·8 ,,	1090

The make of producer gas is 220,700 c.ft. per ton of dry ash-free coke and the calorific value 116 B.Th.U./c.ft.

The percentage decomposition of the water is 72·3% in relation to the total amount present or added as coke moisture, water supplied to the grate, and steam.

The producer efficiency (cold gas) is 80·2% relative to the gross calorific value of the coke as charged. This high figure is chiefly due to the low combustible content of the clinker and to the almost complete absence of flue dust, though the fact that the producers are built into the setting is partly responsible.

In comparison with external mechanical producers, built-in producers offer the advantage that the sensible heat of the producer gas is utilized in the retort setting. The quantity of waste steam is thereby increased.

On the other hand external producers supply a clean gas to the combustion flues of the retorts, and this simplifies operation and increases the life of the setting. Nevertheless, the settings at Baden have been in continuous use for seven years.

The useful scope of mechanical producers has been displaced still further in the direction of large installations through the advent of recent types of grate construction in built-in producers for use with small dust-free coke, since the essentially higher capital, maintenance, and power costs of mechanical producers are now unaccompanied by any appreciable savings beyond those realizable with built-in producers of the step-grate type dealing with low-grade small coke.

A Window Display by the Wolverhampton Gas Company

This photograph is of a display of Wright's new "Console" Radiators, which are rapidly becoming popular owing to their novel design and the cheerful appearance of the lower portion. The card in the centre of the display is worded as follows: "The New 'Console' Radiator. This display is part of the Gas Equipment for a new Church Hall in Wolverhampton."

THE "JOURNAL" TECHNICAL RECORD

Which contains Reports of Meetings of Gas and Allied Associations

North of England Gas Managers' Association

(AUXILIARY SECTION)

The 25th Half-Yearly Meeting of the Auxiliary Section of the North of England Gas Managers' Association was held in the offices of the Newcastle and Gateshead Gas Company, Newcastle, last Saturday.

The Chairman, Mr. C. STANLEY READ, Engineer and Manager of the Gas Department of the Washington Chemical Company, Ltd., presided.

The minutes of the last meeting were taken as read.

The CHAIRMAN said that the Committee proposed Mr. J. B. Henderson, Departmental Superintendent at Wallsend of the Newcastle and Gateshead Gas Company, as Chairman-Elect, and Mr. F. P. Fall, of the Sunderland Gas Company, as Vice-Chairman-Elect. The nominations of the Committee, when put to the meeting, were carried unanimously.

The following paper was then read:

RANDOM REFLECTIONS ON MODERN GAS PRACTICE.

By B. RICHARDSON, Technical Assistant and Chemist, North Shields Gas-Works.

History shows that after a period of war there invariably follows an epoch of unrest and change among the nations involved. That the present is no exception is painfully apparent to all of us whose lot it is to be alive to-day.

On every side old standards are being thrown down and discarded; discontent and poverty stalk across the countries of the world, and owing perhaps to the unprecedented conditions the proposed remedies for these ills have never been proved unreliable in so many cases by the march of events.

The Gas Industry, in common with the rest, has felt the effects of these post-war changes; and it must be a source of pride to those of us who are concerned with its welfare to realize that it has weathered the political and economic storms of the past years in a not unpraiseworthy manner. Nevertheless, as a result of these the course of the Industry has had to be modified from the smooth and pacific track pursued at so steady a rate for so long, and all signs point to a still further modification if the voyage is to be continued without damage or loss of a portion of the cargo.

It will be the object of this short communication to comment, in a cursory manner, upon a few of the modern developments which are occurring in the Gas Industry and the directions in which practice appears to be tending to-day with a prospect of intensified electrical competition immediately ahead.

In the first place, it has been the general rule until quite recently for the technical gas-works staff to concentrate upon the retort house and gas production side of the works. Every effort has been expended to obtain the last cubic foot of gas from the coal and to produce these high yields at the minimum cost. Consequently we have now arrived at the stage when further appreciable improvement in this direction cannot be expected. Modern carbonizing plant has reached a wonderful standard of efficiency, and it is possible for the smallest village gas-works to manufacture gas almost, if not quite, as cheaply as the largest urban undertaking. We have horizontal retort installations from which 72 therms of 560 B.Th.U. gas can be regularly obtained, continuous vertical retorts which can produce from 12,600 c.ft. to 20,000 c.ft. of gas per ton of coal, depending upon the type of coal used, declared calorific value of the undertaking, and degree of steaming practised; and now the intermittent vertical chamber oven has entered the lists. To the mind of the writer this last method of coal carbonization is one with a future, for it combines the advantages of both horizontal and continuous vertical retorts without several of the drawbacks attendant upon these systems.

ADVANTAGES OF VERTICAL CHAMBERS.

The ability to deal satisfactorily with practically all types of gas coal, including small, dusty, and swelling varieties, the possibility of regulating gas output and quality, by the admission of steam toward the end of the carbonizing period, and the fact that a satisfactory hard coke containing a very small percentage of breeze is produced, have all been established for this class of plant, and there appears little doubt that an increasing number will be installed by the larger gas undertakings. In fact, there is a distinct trend towards bulk carbonization throughout the country.

Concurrently with these developments means have been devised for recovering the bulk of the heat from retort settings over and above that utilized for regeneration purposes, by the use of waste-heat boilers.

Finlayson, in a paper read to the London and Southern District Junior Gas Association, has given figures showing that in a continuous vertical installation of modern type it is possible to generate as much as 1500 lbs. of steam per ton of coal carbonized. This is equivalent to 188 lbs. of dry coke; and if it be deducted from the gross figure of 336 lbs. of coke per ton of coal carbonized fed to the producers, the net fuel consumption is only 148 lbs. or 6·6% on coal used. It is obvious that if all the steam so generated can be used, a result of this nature is far in advance of anything claimed for horizontal producer firing.

Nevertheless, waste-heat recovery is going ahead on horizontal installations, and though the amount of steam generated is only about half that obtained on vertical plants, owing to the greater amount of heat carried away in the flue gases of the latter, considerable economies are to be obtained which would be still further apparent were it possible to utilize the sensible heat in the discharged coke in some convenient form of dry quenching plant. Dry quenching plants have indeed been designed, but the high initial capital outlay necessary does not render them an attractive proposition in the majority of cases.

The manufacture of water gas is carried on to-day as a means of providing a low-inert diluent for straight coal gas, and owing to the prevailing high price paid for oil is usually carburetted to a limited extent only.

CARBURETTING.

There seems to be little doubt that the oil supplied for carburetting water gas is of a distinctly inferior quality compared with that of pre-war days. It is generally assumed that one therm of gas can be obtained from one gallon of gas oil when the carburetting and fixing chambers are maintained at the proper temperature conditions, but the experience of the writer is that very seldom is it possible for this figure to be obtained, and that 0·7 therm per gallon is all that can be reached in the majority of cases.

The reason for this is to be found in the increasing world demand for petrol for motor vehicles. It is now the practice to increase the yield of motor spirit from petroleum by subjecting a proportion of the gas oil fraction to a cracking process, when, by distillation under pressure, the oils are decomposed into motor spirit and a residue of greater density than the original oil.

Increasing quantities are being so treated, and it is probable that up to 30% of the total oil now used on water gas plants has been "cracked," with the result that a marked deterioration is to be expected.

It is frequently stated that water gas is more expensive to manufacture than coal gas, and this undoubtedly would appear true in the majority of cases, especially when, as often happens, the water gas plant is worked at infrequent intervals or for short periods each day. To obtain the best

results it is essential that the plant should be worked continuously, otherwise both the make and quality of the gas are unsatisfactory. Two gas analyses are reproduced here. They are of gas generated by the same plant using the same gallonage of oil per run for carburetting, but in the one case (A) gas was being produced continuously throughout the 24 hours and in case (B) the plant was working one shift per day only.

	(A) Plant Working Continuously.	(B) Plant Working One Shift per Day.
Make per run	5383 c.ft.	3100 c.ft.
CO_2	4·2	9·8
O_2	Trace	0·4
C_nH_m	3·2	2·2
CO	37·3	24·5
CH_4	3·3	0·0
H_2	45·1	43·5
N_2	7·0	19·6
Inerts	11·2	29·8
Gross C.V.	391 B.Th.U.	274 B.Th.U.

The marked decrease in the volume and quality brought about by intermittently working the plant is well shown by these figures, and it requires no financial acumen to realize how much more the gas will cost to produce under these conditions.

On the largest undertakings it has become fairly general practice to install mechanically operated units fitted with waste-heat boilers and self-clinkering grates, but if it is intended to produce water gas intermittently then it would seem that these refinements and aids to efficiency are most certainly not worth while, and in fact may prove a definite drawback to the cost of the process.

It is maintained in the case of those works diluting straight coal gas with water gas that it would be cheaper to work a small unit continuously than a larger plant one shift per twenty-four hours. The extra labour costs would be recouped by the increased yield of better quality gas per ton of coke used in the generator.

These are small points worthy of note but there are others of more pressing importance to the gas technician of to-day.

It has been already mentioned that until recently the extraction of the last ounce from the carbonizing plant has occupied a considerable proportion of the manager's time and energy; but now there are distinct signs of a change in outlook.

It is not now so much a question of extracting that extra hundred cubic feet of gas per ton or of reducing the cost of production by the fraction of a penny per thousand, as of turning out our chief product to conform to certain standards of "saleability."

Increasing attention is being paid to the maintaining of a constant calorific value, composition, and specific gravity. The extraction of naphthalene is now standard practice, while gas dehydration has passed well beyond the experimental stage and has been adopted by several Undertakings with a view to improving distribution conditions.

Corrosion.

The advantages of supplying a gas, free from moisture or at least in quantity insufficient to cause saturation at the lowest temperature to which it is likely to be exposed, are many. Chief of all must be accounted freedom from stoppages due to condensed water in the smaller services, and immunity from corrosion deposits in the mains. The latter are invariably initiated by the deposition of liquid water, which acts as a solvent vehicle for the principal corrosive constituents, carbon dioxide and oxygen, present in the gas.

It has been held that hydrocyanic acid is an active agent of corrosion, but the examination of a considerable number of deposits has led the writer to think that its influence as such has been very much overestimated, and voluminous masses of rust recovered from old services have frequently been found to contain a mere trace of prussian blue.

Some few years ago, as the result of a number of tests conducted all over the district, it was found that the hydrocyanic acid content of the gas was remarkably constant and practically the same as that of the gas leaving the works, showing that little, if any, absorption of this compound was taking place in the distribution system.

Hydrocyanic testing is at best a somewhat "messy" operation, and most of the methods devised for its determination are both lengthy and involved.

The writer has introduced a modification which he ventures to outline here as it considerably simplifies the process and checks well against the standard or text-book methods.

The gas is bubbled at the rate of about 1 c.ft. per hour through two wash-bottles containing caustic soda solution to which ferrous sulphate solution has been added. The hydrocyanic acid is absorbed forming sodium ferrocyanide. After passing from 2½ to 3 c.ft. of gas the contents of the absorption bottles are washed out into a beaker and boiled. A few drops of ferric chloride solution are then added, followed by hydrochloric acid until the solution is distinctly acid. A blue precipitate of impure prussian blue is thrown down as follows:

$$3\,Na_4\,Fe(CN)_6 + 4\,FeCl_3 = Fe_7(CN)_{18} + 12\,NaCl$$

The precipitate is filtered and the filter paper well washed with distilled water, after which both it and the retained precipitate of ferrocyanide are thrown into a conical flask. From 10 to 15 c.c. of concentrated sulphuric acid are added, the flask is placed on a hotplate and boiled gently, as nitrogen is estimated in coal by Kjeldahl's method. The filter paper soon dissolves, and in a very short time the solution becomes colourless, when the flask may be allowed to cool. The nitrogen of the prussian blue has now been converted into ammonium sulphate and can be estimated by pouring the solution into a flask containing distilled water, adding excess of caustic soda solution and distilling into a measured quantity of tenth-normal sulphuric acid. The liberated ammonia derived from the nitrogen of the hydrocyanic acid is absorbed by the standard acid and its quantity determined by back-titration. Since every 14 parts by weight of nitrogen are equivalent to 27 parts of hydrocyanic acid, the amount of the latter can be readily calculated.

Standard Quality of Gas.

There are to-day about 705 gas undertakings operating under the Gas Regulation Act with declared calorific values varying from 200 B.Th.U. to 600 B.Th.U., but the bulk of the gas produced is to be found between the limits of 440 B.Th.U. and 510 B.Th.U. Hence, it cannot be maintained that as a result of the freedom to supply gas of the most economical quality conferred by the Act there has been a tendency to lower the calorific value.

In fact, to only a very small fraction of the total output can the term "low grade" be applied, if we assume this to include all qualities of 400 B.Th.U. calorific value or under.

The question arises, and has often been debated, What is the most economical quality of gas to produce? Is there a case to be made out for supplying gas at 360 B.Th.U. as against 500 B.Th.U.?

There are, as is well known, enthusiastic advocates of the former grade who are able to supply us with working figures which appear completely to vindicate their position, but it would seem to the writer that this type of gas has disadvantages which cannot be ignored, the chief of which is the extra cost of distribution.

It must also be remembered that small variations in quality make themselves felt at the consumer's apparatus much more readily in the case of a low than a high calorific gas.

For example, the consequence of a departure in a downward direction of 20 B.Th.U. from a declared value of 360 B.Th.U. would be much more serious than a similar drop in the calorific value of a 500 B.Th.U. gas. In short, an undertaking manufacturing gas of the latter quality has a larger margin of safety to work on without occasioning complaints of "bad gas" on the district.

Seeing that gas appliances are standardized articles, it is pertinent to ask whether it would not be much more satisfactory if the array of diversified gas qualities at present being supplied throughout the country could be replaced by one common grade.

Certainly such a suggestion appears of a Utopian nature, but it is, in the opinion of the writer, one which will seriously have to be considered by our Industry sooner or later. It will doubtless be a difficult matter to decide upon the particular quality of gas which is to become universal.

Each Undertaking working to-day has declared a calorific value which it considers is the most economical to produce, having regard to local conditions, and yet it is possible in congested industrial areas of the country to find two gas companies or municipalities within a few miles of each other, and where local conditions are practically the same, supplying gas of widely different heating value per cubic foot.

With modern types of plant, the difference in cost of manufacturing gas, whether it be produced in horizontal retorts, continuous vertical retorts, or intermittent vertical chamber ovens, is very small, and the choice of a particular installation and calorific value is determined largely by the state of the coke market. The better the price obtained for this residual, the higher the calorific value which will be declared, since less will be converted into gas either by means of a water gas plant by steaming the charge in continuous vertical retorts, or in some cases by complete gasification of the coal.

Unfortunately it is extremely probable that for many

years we shall still have to suffer a multiplicity of calorific values for the reason just outlined, but with the present tendency towards amalgamations, and with the development of " gas grids " in the more densely populated and industrial areas, there is little doubt that appreciable progress will be made in the direction of standardization of the gas supply of the country in the future.

In the meanwhile it is incumbent on every undertaking, whatever the calorific value of the gas it distributes, to endeavour to ensure that this quality is adhered to as closely as possible and that the pressure throughout the district is adequate at all times to meet every need under the severest load conditions.

Even if it were possible for a standard gas to be distributed throughout the British Isles, it does not follow that this gas would everywhere give equal service in consumers' apparatus, for, whereas it is a comparatively simple matter to turn out a product which would test at the declared value in a Boys calorimeter, it is not so easy to ensure an approximately constant composition and specific gravity, for these depend upon the type of plant employed in the manufacturing of the gas and the method of diluting in vogue.

Consider for a moment the case of a 500 B.Th.U. gas. This grade can be obtained by at least six different methods: (1) By straight carbonization of coal in horizontal retorts and reduction to 500 B.Th.U. by practising benzole recovery. (2) By diluting straight coal gas manufactured in horizontal retorts with blue or lightly carburetted water gas. (3) By the addition of producer gas to straight coal gas. (4) By carbonizing in continuous vertical retorts and " steaming " down to the required figure. (5) By carbonizing in intermittent vertical chamber ovens and " steaming " the charge. (6) By the addition of waste gases to straight coal gas.

The accompanying table shows six analyses of gas obtained by the methods just enumerated. All these samples are approximately of 500 B.Th.U. gross calorific value, but it will be noted that the compositions, specific gravities, and volumes of air necessary for complete combustion of one volume of gas, vary considerably in the different examples:

—	(A)	(B)	(C)	(D)	(E)	(F)
CO_2	1·6	2·6	3·3	3·0	2·9	3·4
O_2	0·8	0·3	0·4	·il	0·3	0·5
C_nH_m	2·6	2·6	2·8	1·4	2·3	3·1
CO	6·0	13·2	8·4	11·4	13·6	6·2
CH_4	24·4	27·6	25·7	24·5	24·0	24·8
H_2	52·2	47·5	50·7	52·3	50·6	41 0
N_2	12·4	6·2	8·7	7·4	6·3	21·0
Inerts	14·8	9·1	12·4	10·4	9·5	24·9
Vols. of air to burn 1 vol. of gas	4·3	4·67	4·47	4·25	4·35	4·12
Sp.gr.	0·41	0·443	0·426	0·414	0·433	0·518

(A) Straight coal gas from horizontal retorts after benzole recovery.
(B) Coal gas *plus* carburetted water gas.
(C) Coal gas *plus* producer gas.
(D) Vertical retort gas.
(E) Intermittent vertical chamber oven gas with steaming.
(F) Straight " horizontal " coal gas diluted with waste gas.

The figures show that, while supplying a gas which appears to be of a perfectly constant quality, when tested in a water-flow calorimeter it is nevertheless possible to have at the same time variations of over 10% in the air requirements and nearly 20% in the specific gravity by altering the method of manufacture.

On a large works several different types of gas are usually manufactured, and these are mixed in the purification plant or in the holder in proportions necessary to ensure that the final product is distributed at the declared calorific value. In such cases it is very necessary that frequent determinations of specific gravity should be taken, or, better still, that a continuous record should be kept on a recording type of gravitometer, so that a close control can be maintained on this property and variations detected and rectified. Especially is such a control desirable when water gas is manufactured as an auxiliary to coal gas and the proportion added is being continually altered, or when, for example, benzole extraction is substituted for blue water gas as a means of reducing straight coal gas.

A further examination of the figures given in the previous table reveals the fact that the least satisfactory type of gas included is that obtained by diluting straight coal gas with waste gas, or, in other words, by " over-exhausting " and drawing in furnace gas through the cracks and pores of the retorts. It is unsatisfactory not only because of its large content of the inert constituents carbon dioxide and nitrogen, and consequent high specific gravity, but also on account of the fact that the flame temperature attained during combustion would be much lower than in the case of any of the other examples given, resulting in impaired efficiency for lighting purposes.

It is well known that the best illuminating effects in the incandescent mantle depend not necessarily upon absolute calorific value, but upon the flame temperature of the burning gas, and it is possible for a gas of, say, 450 B.Th.U. to produce a higher intensity of light than one of 560 B.Th.U. This, however, would not obtain if the lower grade gas consisted of straight coal gas diluted by " over-exhausting " to an inert content of 35%, simply because these inerts, nitrogen and carbon dioxide, must be heated to the temperature of the flame, absorb heat in the process, and consequently lower the final flame temperature obtained. A 450 B.Th.U. gas derived from continuous vertical retorts, however, on the other hand, which gives exceedingly good results in incandescent lighting installations, would contain only 9% to 10% inerts, a fact making all the difference in the world.

The Coke Market.

It has just been said that the multiplicity of calorific values throughout the country is due largely to the vagaries of the coke market—a matter of no small importance when it is remembered that coke constitutes from 65% to 75% of the weight of coal used on a gas-works and is responsible for about 20% of the total revenue. Approximately 6½ million tons of coke are disposed of annually, while 40 million tons of coal are consumed domestically, so that there appears here an ample outlet for all the coke gas undertakings can produce, if these domestic consumers can be induced to change over from coal. The prospect of such a change-over is not a particularly rosy one at present, although it may well be asked if the coke producers have left no stone unturned to popularize its use as a smokeless fuel, and so obtain an improved financial return from it.

There is no doubt that the chief drawback attendant upon the use of coke is not its relative incombustibility compared with coal, nor yet the fact that it burns without the production of cheerful flickering flames, but it is the invariably high ash and moisture contents which tend to condemn it. This high ash content of coke is, of course, derived from the coal employed in its production; and the fact that it pays to buy clean coal is becoming apparent to gas undertakings generally. The amount of coal bought to specification is increasing year by year, or at least some effort is being made to control its quality; but the standards as yet set are in most cases not of a particularly high order.

T. H. Prater, in his Presidential Address to the London and Southern District Junior Gas Association in October, 1930, makes a pertinent reference to this question of clean coal. He says: " The purchasing of coal to specification is increasing; and this is indicative of increased technical control in gas manufacturing plant. Clean coal brings many advantages, not the least of which is the resultant production of coke with a low ash content. The amalgamations now taking place within our Industry are assisting materially by their more efficient control of coal buying and analyzing to induce a more widespread practice of coal washing, to the subsequent advantage of the smaller undertakings. The method adopted of producing a clean coke by washing the coke from a dirty coal is strongly to be deprecated."

The writer in the course of an examination of a large number of gas coals drawn from the Durham and Northumberland fields has found the inherent ash of the clean coal as determined by " float and sink " tests to vary between 3·7% and 4·7%. From this fact we gather that were the whole of the shale and pyrites removed by a cleaning process, the ash content of the coal should not exceed 5%.

It would perhaps be unreasonable always to expect perfectly pure coal from the colliery companies, but there can be no justification whatever for the despatching of consignments containing 10% ash or over, as frequently occurs. In fact, there should be no difficulty in cleaning down to 6% ash; and if this figure be exceeded, one may with justice ask whether there has been neglect or carelessness displayed at the pithead. Large lumps of stone and shale are invariably present in badly picked or imperfectly cleaned coal, and these ultimately appear in the coke in the shape of pieces corresponding to the largest size which it is possible for a coal breaker to pass. The inclusion of such visible impurities in the coke is a factor very detrimental from the point of view of " saleability," and the quest for clean coal is one which should be pursued with unrelenting vigour.

Buying Coal to Specification.

Where coal is bought to specification it is obviously necessary that a close check should be kept on the quality of the consignments received, and a suitable control method of testing adopted which can be carried out on practically all gas-works. A few of the largest undertakings possess

coal-testing plants which are in actuality small gas-works; and from these valuable information can be obtained as to the behaviour of particular coals on carbonization. But it is hardly to be expected that such installations can be adopted generally, and, moreover, so elaborate a system demands skilled supervision, while the time occupied in examining each individual coal becomes a serious consideration.

More frequently model coal testing plants, consisting of a small metal retort and purifying plant and capable of dealing with 1/1000 part of a ton, are to be met with, and it is claimed that by their use it is possible to obtain comparative results between different classes of coal and to assess their value to the carbonizer.

It would seem to the writer, however, that the results are not sufficiently reliable to warrant the outlay necessary upon a plant of this type, and in any case, as the late Dr. G. Weyman pointed out, the figures are valueless unless the conditions obtaining are known so that any published results must be regarded with great caution.

For the purpose of the average works which is desirous of keeping a close check upon its coal consignments it is suggested that the following scheme provides the necessary information required as to quality:

(1) Proximate analysis of the coal, which test includes the determination of moisture, volatile hydrocarbons, coke, fixed carbon, ash, and sulphur.
(2) Calorific value of the coal.
(3) Determination of the caking index by the modified Campredon method.

In general the higher the volatile matter the better the coal from a gas-making standpoint, provided the calorific value remains fairly high—say, 13,300 B.Th.U. to 13,600 B.Th.U. per lb., calculated on the dry basis. A high volatile coal of low calorific value is probably oxygenated, so that, although it would appear that large volumes of gas should be evolved on carbonization, in reality this gas would be of poor quality consisting in the main of the two oxides of carbon, and hydrogen. The caking index of such a coal would be under 7, against an average figure of 12 which is obtained for a Durham gas coal. Coals of a caking index 15 and over will be more suitable for coke ovens than for treatment in the carbonizing plant of a gas-works. A high caking index, however, is generally accompanied by a low volatile matter—about 25%. The best gas coals are those which possess both a high volatile hydrocarbon content and a high agglutinating value.

As regards the determination of the calorific value of coal, there are several types of apparatus for this purpose on the market, the most accurate being the bomb calorimeter, which is, accordingly, invariably made use of for research purposes, but is rarely to be found installed in a gas-works laboratory.

The Roland Wild calorimeter, in which coal is mixed with sodium peroxide and fired in a nickel crucible, gives results of a sufficient degree of accuracy for all ordinary purposes, while the writer has found that the Lewis Thompson instrument is not to be despised, for in the hands of an operator accustomed to its use very consistent figures can be obtained.

It is held, therefore, that carefully conducted proximate analyses backed by a calorific value and caking test provide the necessary information required by the generality of gas-works for maintaining a close check upon the quality of the coal consignments received.

If the ash content in coal can be limited to 6%, which is a perfectly reasonable figure to demand from the colliery companies, then it should be easy to sell a coke containing not more than 8% mineral matter, instead of from 14% to 15% as frequently happens to-day.

A great deal has been written on the subject of improving the quality of coke and rendering it more acceptable to domestic consumers by treatment such as de-ashing of the coal from which it is obtained and by blending of different types of coal to yield, on carbonizing, a coke which ignites easily and possesses a high degree of combustibility.

The nature of the after-treatment received by coke has also been commented on as an important factor influencing the final quality, and there seems little doubt that uneven or over-quenching has been responsible, along with the high ash content, for the major portion of the prejudice which has grown up concerning its use.

One of the principal merits urged on behalf of continuous vertical coke is that it leaves the retorts in a dry condition and can be sold containing a minimum of water, whereas it is possible for water-quenched horizontal coke to contain as much as 15% of moisture.

Here is a field for investigation by the gas-works technician—a field as yet almost entirely unexplored. How many undertakings, for example, give any thought whatever to rational coal blending? The usual method of procedure is to tip a truck first of one brand of coal and then of another into the breaker pit and hope for the best while expecting the worst.

It is imperative that the public should be offered a coke low in ash, dry, and of uniform size, and there is no excuse for saying we do not know how to make such a grade, for a great deal of information is available to the Industry concerning the properties of coke required for the various uses. It is cheering to note that increasing efforts are now being made to improve the quality of the coke produced on many works by the installation of elaborate coke handling and screening plants.

Sulphate of Ammonia.

Finally, before bringing these more or less disconnected comments to an end, it is desired to make a brief reference to the sulphate of ammonia situation.

Whereas less than twelve years ago the manufacture of this fertilizer provided an exceedingly profitable source of revenue to gas undertakings, to-day it is difficult to "carry on" without losing money in the process, and ammonia, from being regarded as a valuable bye-product, is now looked upon as a nuisance to be got rid of in the cheapest way possible.

Such is the state of affairs obtaining as the result of the building-up of a huge synthetic nitrates industry in many countries of the world—including Japan, a nation which until recently took a large percentage of the bye-product sulphate of ammonia manufactured in the gas-works and coke oven plants of Great Britain.

Suggestions have been made with a view to cheapening the cost of producing gas-works sulphate by a modification of the manufacturing process, but it does not appear that much, if any, relief would accrue from the adoption of these.

The merits of the direct and semi-direct processes as carried on almost universally in coke ovens have been urged over the usual indirect gas-works method, and the new sulphate of ammonia plant at the Partington Works of the Manchester Corporation is of the semi-direct type.

That these systems are likely to come into general use on gas-works is exceedingly improbable. Appreciable cheapening of the cost of sulphate manufacture can only be brought about, it would seem, by cutting out the use of the costly sulphuric acid or by manufacturing ammonium compounds other than sulphate, such as the chloride and carbonate, for which markets would have to be found.

The possibility of the employment of calcium sulphate instead of sulphuric acid as the source of the acid radicle in the production of sulphate of ammonia has been examined. The general opinion appears to be that the process is essentially one for a central chemical works taking concentrated liquor from a gas-works, and is not suitable for adoption on a gas-works itself.

Consequently we are led to ask whether there are commercial possibilities in the elegant method suggested by Prof. J. W. Cobb some few years ago, and which seems worthy of consideration. The essentials of the process are the following: Crude coal gas (after extraction of tar) is passed through a solution of zinc sulphate, when, in the presence of the hydrogen sulphide and ammonia in the gas, the zinc sulphate is converted into ammonium sulphate, and insoluble zinc sulphide is formed.

$$ZnSO_4 + NH_3 + H_2S = (NH_4)_2\,SO_4 + ZnS.$$

The zinc sulphide is subsequently oxidized to sulphate by agitation in a current of air.

$$ZnS + 2O_2 = ZnSO_4.$$

So that a given quantity of zinc sulphate will produce an indefinite amount of sulphate of ammonia.

The process seems quite feasible to conduct on the large scale, and it is mentioned here for your consideration and further investigation.

One is inclined to ask at the present time, What is the future of the Gas Industry? A huge Government-aided electrical supply scheme, with tentacles extending into every corner of the country, is nearing completion, and strenuous efforts will be made to ensure its success.

Already the railways are being told that the steam locomotive is obsolete as a prime mover and that salvation will be found only when complete electrification of the main lines is an established fact—this in face of the mixed results attending main line electrification schemes on the Continent and in South Africa and India.

The full force of the electrical offensive will fall upon the Gas Industry in a few years' time, but the result can never be in doubt if in the days before us we concentrate upon the utilization aspect of the business to the same extent as the production side. Doubtless there will be a hard fight ahead, but we were never in a better position to meet it as far as technical equipment is concerned, though there is

still scope for an intensification of practical as opposed to purely academic research in every branch of activity. The more research of this nature, the sooner the results can be handed on to the consumers, and the more satisfied the consumers, the more gas will be required, and the day upon which we can in all truthfulness speak of gas as the "Fuel of the Present" will be brought a little nearer.

In conclusion, the writer wishes to express his thanks to Mr. F. P. Tarratt, the Chief Engineer to the Newcastle-upon-Tyne and Gateshead Gas Company, for permission to produce these notes.

Discussion.

The CHAIRMAN said the question of gas of varying qualities in various places was an important one and was a definite "snag" to manufacturers of gas appliances. He had recently talked to representatives of different gas appliance firms, and in both cases they had asked him what he considered was an ideal calorific value. This was a question which could not be answered out of hand. The ideal was that every gas undertaking should work to a standard calorific value. In regard to buying coal to specification, coal very often did not come up to sample, and it meant they had to keep in close touch with the collieries to see that consignments agreed with contract.

Mr. A. H. BAGSHAW, of Sunderland, asked what type of coke was obtained from intermittent vertical chambers. Was it a dense coke, or one having a ready sale for domestic purposes? In regard to oil for carburetting, they at Sunderland had had similar results as those which the author had mentioned. He could not agree with the figures given for regular and intermittent work of the water gas plant. They seemed to indicate that something might be done to get better results when the plant was working irregularly. He thought that leaving the clinker doors open two or three hours before the plant was required might give better results. More attention should be paid to heat insulation. They could insulate the top of the horizontal retort bench, but was it possible to insulate the front walls of the bench?

Mr. F. NICHOLLS, of the Newcastle-upon-Tyne and Gateshead Gas Company, referring to the use of benzole, said that in the earlier years there had been a lot of adverse criticism. This was not the fault of the benzole, but of the people who used it, who seemed to think that their cars should run without thought at all on their part. They never thought of adjusting the carburettor jet or of making similar adjustments. With benzole there was a tendency for gum to form on the valves of the engine, due to the oxidation of certain unsaturated hydrocarbons. The way to get rid of these substances was by washing, but that also removed certain unsaturated substances which had a definite heat value and were of certain anti-knock value also. On the Continent, they had tackled the problem with several new methods which would not pass the test in this country. Because of this, those methods had been held up in this country. As to clean coal, Mr. Nicholls said that he was strongly in favour of cleaner coal; but if they were going to ask the collieries for cleaner coal, then he thought they would have to be more definite as to what they wanted. Engineers had different requirements. Some thought that considerable improvement might be made at the pithead in hand picking, but he was doubtful about that. Mr. Richardson had suggested that they might get a reduction to 5% of ash. He remembered a colliery company against which his own undertaking had had reason to complain. They had taken part of a consignment to one part of the works, and there they had had it sifted; but from that experience he did not think that hand-picking would bring an improvement to 5% of ash. The bulk of the ash was in smalls, and was not easily picked out by hand. Mr. Nicholls said he was not an advocate of low-quality gas, and believed in gas of 560 B.Th.U. or thereabouts.

Mr. C. NEIL, of West Hartlepool, referring to cleaned coal, said that until recently his works had used Durham unscreened coal, but they had received complaints about the quality of the coke. Then they started to use washed single nuts. He had heard it said that the moisture content was high in this class of coal, but they only got 2¼% moisture, and the ash was consistent at 4 to 5%. There were certain benefits from this class of coal. The coke contained about 7% of ash. The hectolitre measure had considerably improved due to the nutty nature of the coal. It could be packed tightly in the retort.

Mr. J. W. PALLISTER, of Middlesbrough, discussing the question of a standard gas, said that consumers' appliances would require standardizing.

THE AUTHOR'S REPLY.

Mr. RICHARDSON, referring to Mr. Bagshaw's remarks on horizontal and vertical retorts, said that as far as the figures were concerned they could get what they liked on water gas, depending on the amount of steam, and he thought it was better to give volume of gas. He said that he knew of two places in the South where the coke from intermittent vertical chambers had a ready sale. As to insulation on the fronts of horizontal retorts, he did not think that it paid. Replying to Mr. Nicholls on the question of low-grade gas, Mr. Richardson said that he had had actual experience of low-grade gas, particularly in small towns and villages in Yorkshire, where 400 B.Th.U. gas was being used. In one house he had to adjust the gas every night for a week. The last time he had been to that house he found electric light. He could not agree with Mr. Nicholls in his remarks on hand-picked coal, and that ash could not be reduced to 5% by hand-picking. He still thought they could ask the collieries to clean down to 6%. Replying to Mr. Pallister, Mr. Richardson said that he was an advocate of high-grade gas. He did not think any gas below 450 B.Th.U. was "worth looking at." If there was a common calorific value in, say, Yorkshire, he thought there would be greater satisfaction to the consumer.

VOTES OF THANKS.

Mr. F. NICHOLLS proposed a vote of thanks to Mr. Richardson for his paper, and Mr. W. O. KIRKWOOD, of Sunderland, seconded.

Mr. A. H. BAGSHAW, until recently Hon. Secretary of the Auxiliary Section, proposed a vote of thanks to the Chairman, the Hon. Secretary (Mr. L. M. Weldon), and members of the Committee. Mr. R. L. ATKINSON, of Newcastle, seconded the vote.

The CHAIRMAN referred to the death of Mr. Matthew Dunn, of Darlington, and formerly of Stockton, and said that it was with great regret that the Section had learned of the death of so able and highly esteemed a member.

At the conclusion of the meeting, tea was served in the Gas Company Offices.

Midland Junior Gas Association

Address by Prof. F. W. Burstall

A Meeting of the Association was held in Birmingham on Nov. 10—Mr. F. A. C. PYKETT (the President) in the chair.

ECONOMIC UTILIZATION OF FUEL.

By Prof. F. W. BURSTALL.

Prof. Burstall said that an answer could not be given to the question "What is the temperature of a flame?" without a statement of what was meant exactly by temperature. It was necessary to define the exact point at which the temperature was to be measured. The differences of flame temperatures were caused by the various layers of the flame in which combustion was taking place. Conditions affected the flame and caused it to go to a higher or lower mean temperature; the most important thing was the question of inerts. Air contained 80% of inert nitrogen, and that was the reason for the use of pure oxygen for very hot flames. Twenty years ago we knew comparatively little about the question of the mixing of the air and gas in order to produce rapid combustion. Temperatures depended upon the speed at which the flame could be propagated; and that depended upon the mixture between the gas and the air. Air and gas would mix and give complete combustion, but it was not easy to get complete combustion rapidly. A common practice was to let the air and gas mix before passing through a wire mesh. Provided the mesh was fine and the wire did not get hot a fairly intimate mixture was ensured. From a practical point of view, however, it generally failed; if the wire got heated then the flame could strike back into the mixing chamber.

The best practical method for the rapid mixing of gas and air was to allow the two streams to pass through very fine narrow slits so arranged that the two streams converged. The Birmingham Gas Research Department had found this method efficacious. There was no fear of the flame striking back, because the velocities through the slits were very high. Another good form of mixing was with the porous plate. The gas and air were allowed to soak through minute holes, and ignition took place on the other side. This method was known as surface ignition. It had been used with efficient results but there were practical difficulties in finding a plate sufficiently porous to stand up to the heat on one side without damage, and in getting a sufficient quantity of gas and air through a given area.

The Professor next referred to the value of turbulence. He assumed that both gas particles and air particles not merely had a lineal motion but that they rotated as well. The importance of turbulence could hardly be over-estimated in the mixing of gases, because the more turbulent the mixture was the more rapid would be the combustion. Then there was the question of radiation which was of

importance. Pure radiant heat was heat given out by a hot wire or refractory or any material in which no apparent chemical change took place when it was heated. He said apparent, because so far as he understood it chemical action was always taking place, although it might be very slow. The loss of heat of a hot body by radiation depended upon the temperature of the surface which was receiving the heat and the area of the surface which was giving out the heat. The results were the same in the case of flames, and they explained why the various forms of burners were used for various purposes. They all knew that a hot body or flame emitted waves of different lengths, and these varied from what was called the infra red or invisible heat ray, to the ultra violet or invisible light way, which the eye could not see but which powerfully affected it for harm. The best light for the human eye was one in which the yellow ray was present, and not too much white light, in which the violet ray was always present. Another question, which he could not answer, was that of the cold light emitted by the glow worm or firefly. It might be that in future cold light would be the means by which illumination would be obtained.

The great advantage of gas was its immunity from imperfect combustion; and the fact that it could be controlled with accuracy. For many purposes a gas flame was essential in the working of metals, as it could be so readily controlled in temperature by an alteration in the amount of air, and the size of the flame could be varied through wide limits. This was invaluable in hard and soft soldering and in welding, in which gas was widely employed. The use of gas for melting metals, heating furnaces, annealing, and so forth was nearly perfect, affording ease of control and clean working. He was confident that town gas would ultimately be used for all metallurgical operations, providing the cost could be brought down, as it certainly would be if the load factor was brought up.

Vote of Thanks.

Dr. C. M. Walter (Industrial Research Laboratories, Birmingham Gas Department), in moving a vote of thanks to Prof. Burstall, said that when estimating flame temperatures it had to be realized that combustion took time. The methods outlined certainly tended to the perfect mixing of gas and air. The Professor had pointed to great possibilities of gas for industrial heating; and his (the speaker's) hope was that his views would actually come true within his lifetime. He felt that the day appeared to be not so far distant as many might suppose.

Mr. T. F. E. Rhead (Chief Chemist, Birmingham Gas Department) seconded the resolution.

A Visit to the Veritas Mantle Factory

It is almost seven years since members of the London and Southern District Junior Gas Association visited the "Veritas" Works of Messrs. Falk, Stadelmann, & Co., Ltd., in Garratt Lane, Wandsworth; and, by the kind invitation of the firm, they were given the opportunity, on Wednesday, Nov. 30, of once again making themselves *au fait* with a most important phase of the Gas Industry's activities—namely, that of manufacturing gas mantles.

The Works.

The "Veritas" factory, which occupies an area of 6¾ acres, was taken over by Messrs. Falk, Stadelmann, & Co., Ltd., in 1919, and constitutes, perhaps, one of the largest works of its kind in the country. Designed for an annual output of more than 20 million gas mantles, the works possesses the most up-to-date machinery and employs some 500 workpeople.

The raw materials are monazite sand, the Tschuma plant, and artificial silk. The first is found mainly in Brazil and Travancore, and from it thoria is extracted and converted into thorium nitrate. From the second—which is a native of the plains of the Yang Tse Kiang—is spun ramie thread, which forms the carrier of the thorium nitrate and the other chemicals used during the course of manufacture. Artificial silk is employed to a large extent as a carrier instead of ramie.

To ensure that the high standard of quality found in "Veritas" mantles is always maintained, samples of the work passing through the factory are taken at regular intervals, and submitted to drastic tests as regards their behaviour both under vibration and on the burner. Should any samples prove to be defective, search is at once made for the cause of the trouble, so that it may at once be remedied. If any such samples show a bad result on testing, the batch from which they are taken is not sent out.

The factory is well equipped with up-to-date and extensive plant for printing and box-making.

At the conclusion of the tour of inspection, the visitors were entertained at tea, Mr. Max Falk, Chairman of the Company, presiding, supported by Mr. Cecil Falk, and other senior officers, Mr. A. Tennant, President of the Association, and Mr. F. H. Higton, Hon. Secretary.

Mr. Max Falk said that it gave him great pleasure to welcome the Association to their works. He understood that this was their second visit, which encouraged him to think that they had given the visitors food for reflection; the Company were honoured by their visit that day. The members of the Industry had the actual knowledge of their requirements, and Messrs. Falk, Stadelmann, & Co. welcomed advice and information as to what was desired. They were connected with an industry that was very prosperous—and this in spite of so-called electrical competition. Each, however, had its uses, and each had its failings; but so far as gas lighting was concerned, it was the means of lighting the homes of the vast majority of the populace. Not only did it flood the rooms with light, but it shed an agreeable warmth as well; and when they studied statistics it would be found that the preponderance of dwelling-houses used gas for lighting.

The Company, he continued, had from early days been connected with the Gas Industry—as far back as 1882. The Gas Industry, he said, was one of the finest industries in the country, and one could not read the Technical Press without being impressed by its immense increase in output. He went on to refer to the new daylight mantle which the firm were producing, which was very suitable for use in works and factories where the matching of colours or textile work was carried out. In the floodlighting field also these daylight mantles were being used with some success. It was about a quarter of a century ago that Messrs. Falk, Stadelmann, & Co. first put their "Veritas" incandescent mantles on the market.

Mr. Tennant proposed a hearty vote of thanks to Mr. Falk and the Company for this invitation to visit their works and for their hospitality. The large attendance of members was an indication of the interest they took in gas lighting. There was no doubt that these works were the most up-to-date of their kind in the country, and the mantles that were produced were of excellent quality. The Gas Industry was dependent on the manufacturers for the quality of the products they had to sell to their consumers, and it was an advantage to them to know how the goods were manufactured. It was satisfactory to know that they were handling materials of such a high quality. Many people would have them think that the gas lighting business was a dying one, but there was a great deal of scope for development yet. If there was no increase in output on the part of Messrs. Falk, Stadelmann, & Co. it was due to the higher quality of mantle they were producing.

Mr. Tennant went on to suggest that there was the possibility of the use of gas mantles other than for lighting purposes, and cited a statement made in one of the discussions before the recent meeting of the Institution of Gas Engineers to the effect that a gas fire might be produced which replaced the existing type of radiant with incandescent mantles, suitably screened. It was a fact that the incandescent mantle produced a more useful form of heat with a wave-length very closely approximating to that of the sun's rays. In conclusion, Mr. Tennant thanked the firm once more for their hospitality, and coupled with the vote the names of those gentlemen who had shown them over the works.

Mr. C. I. Winstone (Public Lighting Superintendent to the Gas Light and Coke Company) seconded the vote of thanks.

Gas Companies' Results.

Alcester.

The Alcester Gas Light, Coal, and Coke Company has declared a dividend of 8% on the ordinary shares. Mr. George Haines has been re-elected Chairman and Managing Director for the ensuing year.

Churnet Valley.

The Directors of the Churnet Valley Gas Company, Ltd., present a report and statement of accounts for the year ended Sept. 30, 1932, stating that the revenue account shows a profit of £759. To this has to be added the unappropriated balance from the previous year £691, making a total of £1450. Against this has to be charged debenture interest for the year of £276, and bank interest amounting to £97, making together £373. This leaves for disposal the sum of £1076, which the Directors recommend shall be applied in the following manner—viz., by carrying to reserve the sum of £250, and by carrying forward to the current year the balance of £826.

Messrs. Stewarts & Lloyds' Big Steel Project

An event of prime importance to the whole of the British steel industry is announced in the decision of Messrs. Stewarts & Lloyds to re-start in this country the manufacture of basic Bessemer steel.

Control has been obtained of an orefield covering 26,000 acres in Northamptonshire and containing 500 million tons of suitable reserves. The field is to be developed on a large scale and a completely modern steel plant and tube-making works erected on the spot without delay. The new works will be designed as a self-contained unit undertaking every process for the conversion of the raw material into the finished steel tube. Great economies are visualized both in manufacturing costs and transportation charges.

In a circular issued to shareholders it is pointed out that the raw materials are the iron-ore deposits of Northamptonshire. These are one of the greatest ore-beds in the world. The Directors have recognized for a number of years that these deposits were of great potential value and could be utilized to produce steel wholly from British materials at a cost thoroughly competitive with the best Continental practice and of a high standard of quality. Full-scale experiments and exhaustive trials have proved that their composition is particularly suited for the production of steel of basic Bessemer quality.

At the present time, it may be noted, there is no home source of supply of basic Bessemer. In the early part of the century this country produced nearly 700,000 tons, while even immediately before the war the British output was rather more than 500,000 tons. Britain's supplies now come almost entirely from France and Belgium, the last production of any consequence in this country being 28,300 tons in 1925.

The great importance of producing basic steel within the country and from home raw materials can readily be understood when it is realized that of the large quantities of steel yearly imported the major portion of the cheaper classes consists of steel manufactured by this process.

With these facts in mind, the Directors of Messrs. Stewarts & Lloyds decided to extend and consolidate the Company's holding of Northamptonshire ore.

Completely Self-contained.

By this arrangement there will be an integrated unit securing a continuous programme of manufacture from the ore to the finished tube. The production of basic Bessemer steel will be commenced as soon as the works can be in operation.

The erection of this combined plant will mark yet a further step in the policy of rationalization and concentration which the Company has been pursuing over a number of years. It will, in effect, be one of the most remarkable developments ever witnessed by the British steel industry.

Among other things, it will entirely eliminate any transport outside the Company's own works during the processes of manufacture. Large-scale economies will be achieved.

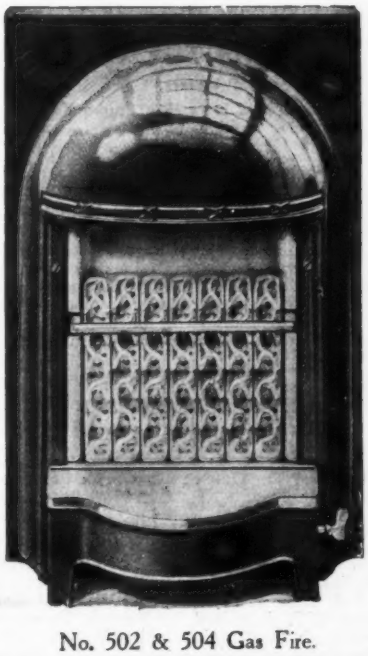
A total of £3,300,000 will be necessary to meet the cost of construction, including what has been already spent in consolidating the iron-ore position in Northamptonshire. A powerful financial group of bankers and others has been formed to provide this money through the offices of the Bankers' Industrial Development Company. The Directors have been able to arrange that the money shall be advanced by way of a loan, as and when required, on terms which are very advantageous to the Company. In order to obtain the best terms possible it has been agreed to assign to trustees, as security for the loan, the whole of such assets of the Company as are assignable.

When the new plant is finished the products of the Company will be wholly British, both in workmanship and material, the economic situation of the Company will be strengthened and its competitive position secured. The scheme will enable the Company not only to supply the home consumer at the right price, but to see that this country gets its proper share of the tube export markets. Projection of the scheme is described as not only of fundamental economic importance to the Company itself, but as marking an important step in the development of the nation's iron and steel industry.

CARRON

GAS FIRES.

By Appointment Ironfounders to H.M. the King.



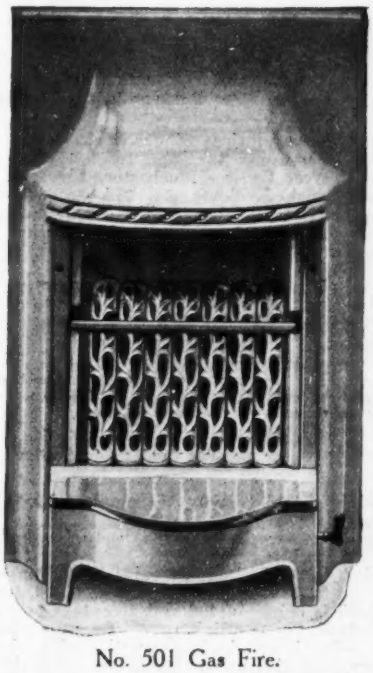
No. 502 & 504 Gas Fire.

¶ Intense Heat.

¶ Simple Regulation.

¶ All Parts Accessible.

¶ Made in a Variety of Finishes.



No. 501 Gas Fire.

Write for No. 6R Gas Appliance Catalogue, post free.

CARRON COMPANY
FOUNDED 1759.

Works:—CARRON—STIRLINGSHIRE.

GAS MARKETS & MANUFACTURES

Stock Market Report.

[For Stock and Share List, see later page.]

Conditions on the Stock Exchange last week were much brighter than anticipated, for while the result of the War Debts controversy still remained in doubt it became evident that even if the instalment due on Dec. 15 is paid no serious reactions will arise. The gilt-edged market came into its own again and was the centre of activity. Prices recovered substantially, and this week may see still further improvements. In most of the other markets business was on a small scale, though the tone remained firm.

The volume of business in Gas stocks and shares was unusually heavy, and, though there were few changes in the quotations, many transactions were recorded at prices a shade higher than those of the previous week. It will be seen from the Stock and Share List that all the increases occurred in ordinary stocks. These stocks nowadays are receiving a large measure of support, and it is clear that they are appealing to a very much wider investing public than hitherto. Debentures, of course, remain popular for those requiring the added security. The majority of them now yield in the region of 4%, so that, having regard to the yields now obtainable on gilt-edged securities, it cannot be expected that much in the way of capital appreciation will accrue in the future. It may be added that the current prices in many instances include nearly six months' interest.

Current Sales of Gas Products.

The London Market for Tar Products.

LONDON, *Dec.* 5.

There is little change to report in the prices of tar products, which are as follows:

Pitch is firm at 100s. per ton f.o.b.

Creosote is 3½d. to 5d. per gallon f.o.b., according to specification.

Refined tar is 4d. to 4¼d. per gallon in bulk at makers' works.

Pure toluole is about 2s. 5d.; pure benzole, about 1s. 11d. to 2s.; 95/160 solvent naphtha, about 1s. 8d.; and 90/140 pyridine bases, 3s. 9d. to 4s.—all per gallon naked at makers' works.

Tar Products in the Provinces.

Dec. 5.

The average prices of gas-works products during the week were: Gas-works tar, 33s. to 38s. Pitch—East Coast, 85s. f.o.b. West Coast—Manchester, Liverpool, Clyde, 85s. f.o.b.* Toluole, naked, North, 1s. 7½d. to 1s. 9d. Coal-tar crude naphtha, in bulk, North, 5½d. to 5¾d. Solvent naphtha, naked, North, 1s. 4d. to 1s. 4½d. Heavy naphtha, North, 10½d. to 11d. Creosote, *ex* works, in bulk, North, liquid and salty, 2¼d. to 2⅜d.; low gravity, 1¼d.; Scotland, 2¼d. to 2⅜d. Heavy oils, in bulk, North, 4¾d. to 5¼d. Carbolic acid, 60's, 1s. 6½d. to 1s. 7d. Naphthalene, £9 to £10. Salts, 55s. to 75s., bags included. Anthracene, "A" quality, 2½d. per minimum 40 p.ct., purely nominal; "B" quality, unsaleable.

* All prices for pitch are now quoted on the basis of f.o.b. In order to arrive at the f.a.s. value at any port it will be necessary to deduct the loading costs and the tolls whatever they may be.

Tar Products in Scotland.

GLASGOW; *Dec.* 3.

While actual turnover is small, prices of most products remain fairly steady.

Crude gas-works tar.—The actual value is 45s. to 50s. per ton *ex* works.

Pitch.—Nominal export value is unchanged at 92s. 6d. to 95s. per ton f.o.b. Glasgow. For home trade, 100s. per ton *ex* works in bulk is being quoted and accepted.

Refined tar to Ministry of Transport Specification is quiet, but value is steady in sympathy with pitch. To-day's prices range from 3¾d. to 4d. per gallon *ex* works naked according to quantity.

Creosote oil.—There is a continued lack of demand, and prices are irregular. B.E.S.A. Specification is 3½d. to 3⅝d. per gallon; low gravity, 3d. to 3½d. per gallon; and neutral oil, 3½d. to 3¾d. per gallon—all *ex* works in bulk.

Cresylic acid.—Conditions are unsatisfactory, with prices more or less nominal. Pale, 97/99 p.ct., is 11d. to 1s. per gallon; dark, 97/99 p.ct., 10d. to 11d. per gallon; and pale, 99/100 p.ct., 1s. 2d. to 1s. 3d. per gallon—all f.o.r. in buyers' packages.

Crude naphtha.—Available supplies continue to command 4½d. to 5d. per gallon f.o.r., according to quantity and quality.

Solvent naphtha.—There is more inquiry, but values are unchanged at 1s. 2d. to 1s. 3d. per gallon for 90/160 grade, and 11d. to 1s. per gallon for 90/190 grade.

Motor benzole.—Supplies are not too plentiful at 1s. 4d. to 1s. 5d. per gallon *ex* works.

Pyridines.—90/160 grade is 3s. to 3s. 3d. per gallon, and 90/140 grade 3s. 3d. to 3s. 6d. per gallon.

Benzole Prices.

These are considered to be the market prices for benzole at the present time.

	s. d.		s. d.	
Crude benzole	0 10½	to	0 11	per gallon at works
Motor "	1 6½	"	1 7	" " "
Pure "	1 10	"	1 11	" " "

Contracts Advertised To-Day.

Excavating and Laying and Jointing Mains.

The Torquay and Paignton Gas Company invite tenders for above work. [Advert. on p. 706.]

Benzole Recovery, &c., Plant.

The Manchester Corporation Gas Department invite tenders for the supply of plant for the recovery and subsequent treatment of benzole. [Advert. on p. 706.]

Trade Notes.

Some Robert Jenkins' Products.

A comprehensive catalogue of their products has been published by Messrs. Robert Jenkins & Co., Ltd., of Abbey House, Victoria Street, S.W.1. Particulars and illustrations are given of new lines in welded mild steel boilers for domestic hot water supply, while many other types of boilers, chemical plant, storage tanks, calorifiers, road wagon tanks, oil fuel tanks, dryers, heat exchangers, &c., are dealt with. The firm was established in 1856, and the works at Rotherham occupy an area of more than six acres, producing over 400 tons of welded work per month.

Parliamentary Intelligence.

[From Our Special Correspondents.]

House of Lords.

Special Orders.

The following Special Orders have been laid before the House and referred to the Special Orders Committee: Coatbridge Gas Company and Liverpool Gas Company.

Joint Committee on Basic Prices.

On the motion of the Earl of Onslow, the Chairman of Committees, a Committee of five Lords has been appointed to join with a Committee of the House of Commons to consider and report on the basic price system of charge by gas undertakers. The following Lords have been appointed: Viscount Hereford, Lord Chesham, Lord Meston, Lord Rhayader, and Lord Hutchison of Montrose. The House of Commons members of the Committee have not yet been nominated, but the House of Commons has concurred in the appointment of a Joint Committee.

House of Commons.

Special Orders.

The following Special Orders have been presented and ordered to lie upon the Table of the House: Coatbridge Gas Company and Liverpool Gas Company.

New Gas Company Bills.

Among the 52 Private Bills deposited on Nov. 27 for the coming session appear the following: Commercial Gas Bill, South Metropolitan Gas Bill, South Suburban Gas Bill, deposited by Messrs. Sherwood & Co.; East Hull Gas Bill and Gas Light and Coke Company Bill, deposited by Messrs. Dyson, Bell, & Co. The Middlesbrough Corporation and Sidmouth Urban District Council Bills also contain important sections dealing with gas.

STOCK AND SHARE LIST.

Official Quotations on the London and Provincial Stock Exchanges.

[For Stock Market Report, see earlier pages.]

Issue.	Share.	When ex-Dividend.	Dividends. Prev. Hf. Yr.	Dividends. Last Hf. Yr.	NAME.	Quotations. Dec. 2. (Provincial Exchange Dec. 3.	Rise or Fall on Week.	Transactions. Lowest and Highest Prices During the Week.
£			% p.a.	% p.a.				
1,561,868	Stk.	Oct. 3	7⅛	7⅛	Alliance & Dublin Ord. ...	102—112	...	108—109
374,000	,,	July 4	4	4	Do. 4 p.c. Deb. ...	80—90	...	...
557,055	,,	Aug. 22	7	7	Barnet Ord. 7 p.c.	132—142	...	...
300,000	1	Oct. 17	1/9⅔	1/4⅓	Bombay, Ltd.	21/—23/-	...	22/6—22/9
177,750	Stk.	Aug. 22	9	9⅓	Bournemouth sliding scale	192—202	...	...
550,050	,,	,,	7	7	Do. 7 p.c. max. ...	145—155	...	149½—150
439,160	,,	,,	6	6	Do. 6 p.c. Pref. ...	135—140	...	136½—137½
50,000	,,	June 20	3	3	Do. 3 p.c. Deb. ...	75—80	...	...
162,025	,,	,,	4	4	Do. 4 p.c. Deb. ...	100—105	...	122—124
210,000	,,	,,	5	5	Do. 5 p.c. Deb. ...	122—127	...	...
357,900	,,	Aug. 22	7½	7½	Brighton, &c. 6 p.c. Con. ...	140—145	...	129—130
540,000	,,	,,	6½	6½	Do. 5 p.c. Con. ..	127—132	...	...
195,500	,,	,,	6	6	Do. 6 p.c. B Pref.	135—145	...	...
1,287,500	,,	Aug. 8	5	5	Bristol 5 p.c. max.	108—110[a]	...	...
120,420	,,	June 20	4	4	Do. 1st 4 p.c. Deb. ...	96—99[a]	...	...
217,870	,,	,,	4	4	Do. 2nd 4 p.c. Deb. ...	95—98[a]	...	...
328,790	,,	,,	5	5	Do. 5 p.c. Deb.	115—120[a]	...	...
855,000	,,	Oct. 3	8	7	British Ord.	141—146	...	145½—146
100,000	,,	June 20	7	7	Do. 7 p.c. Pref.	140—150	...	...
350,000	,,	—	—	—	Do. 5½ p.c. Pref. ...	107—112	...	...
120,000	,,	,,	4	4	Do. 4 p.c. Red. Deb. ...	90—95	...	...
450,000	,,	,,	5	5	Do. 5 p.c. Red. Deb. ...	105—115	...	...
160,000	,,	July 4	5	5	Cambridge 5 p.c. Deb. ...	117—122	...	...
100,000	10	May 23	6	6	Cape Town, Ltd.	7½—8½	...	...
100,000	10	Nov. 7	4½	4½	Do. 4½ p.c. Pref. ...	6—7*	...	...
150,000	Stk.	June 20	4½	4½	Do. 4½ p.c. Deb. ...	90—95	...	...
626,860	,,	Aug. 8	6	6	Cardiff Con. Ord.	102—107	...	...
237,860	,,	July 4	2½	5	Do. 5 p.c. Red. Deb.	105—110	...	...
157,150	,,	Aug. 8	5½	5	Chester 5 p.c. Ord.	93—98[a]	...	...
98,936	1	Oct. 17	2/-	2/-	Colombo, Ltd. Ord.... ...	25/—30/-	...	...
609,204	1	Oct. 17	-/10'90	-/11'47	Colonial Gas Assn. Ltd. Ord.	17/—19/-	...	...
296,052	1	,,	1/2'54	1/3'30	Do. 8 p.c. Pref.	19/—21/-	...	...
1,822,505	Stk.	Aug. 8	5½	5	Commercial Ord.	104—109	...	105—106
475,000	,,	June 20	3	3	Do. 3 p.c. Deb. ...	74—79	...	78
240,744	,,	—	—	—	Do. 5 p.c. Deb. ...	119—124	...	121
807,560	,,	Aug. 8	7	7	Croydon sliding scale ...	138—143	+1	140—143
469,590	,,	,,	5	5	Do. max. div.	95—100	...	...
500,000	,,	July 4	5	5	Do. 5 p.c. Deb.	120—125	...	...
542,270	,,	Aug. 8	10	7	Derby Con.	150—160[e]	...	...
55,000	,,	July 4	4	4	Do. 4 p.c. Deb.	75—85[e]	...	...
209,000	,,	Sept. 5	5	5	East Hull Ord. 5 p.c. ...	97—102	...	...
179,500	,,	Aug. 22	5½	5	East Surrey Ord. 5 p.c. ...	108—118	...	...
155,019	,,	June 20	5	5	Do. 5 p.c. Deb. ...	118—123	...	118—119
1,002,180	,,	Sept. 19	16⅔	15	European, Ltd.	122—127	...	124½—126½
19,105,992	,,	Aug. 8	5⅔	5⅔	Gas Light & Coke 4 p.c. Ord.	23/—25/-[f]	...	23/6—24/-
2,600,000	,,	,,	3⅔	3⅔	Do. 3½ p.c. max.	80—85	...	80½—82
4,477,106	,,	,,	4	4	Do. 4 p.c. Con. Pref. ...	99—102	...	99—100½
6,102,497	,,	June 20	3	3	Do. 3 p.c. Con. Deb. ...	79—83	...	79—80½
3,642,770	,,	,,	5	5	Do. 5 p.c. Red. Deb. ...	111—116	...	114—115
3,500,000	,,	,,	4½	4½	Do. 4½ p.c. Red. Deb. ...	108—112	...	...
264,011	,,	Aug. 22	—	6	Harrogate New Cons. ...	110—115	...	...
82,500	,,	Aug. 22	7	7	Hastings & St. L. 5 p.c. Conv.	130—140	...	...
258,740	,,	,,	5½	5½	Do. 5 p.c. Conv.	102—107	...	105½—107
70,000	10	Oct. 17	†10	†10	Hongkong & China, Ltd. ...	9½—10½	...	...
218,200	Stk.	Aug. 22	6	6	Hornsey Con. 5½ p.c. ...	117—122	...	118—118½
5,600,000	,,	Nov. 21	14	10	Imperial Continental Cap.	195—205*	...	197½—204
223,130	,,	Aug. 8	3½	3½	Do. 3½ p.c. Red. Deb.	90—95	...	91½
235,242	,,	Aug. 8	5⅔	5⅔	Leo Bridge 5 p.c. Ord. ...	162—162	...	...
2,145,907	,,	Aug. 22	6	6	Liverpool 5 p.c. Ord. ...	118¾—120½[b]	+1	...
245,500	,,	June 20	5	5	Do. 5 p.c. Red. Pref. ...	100—110[b]	...	...
306,083	,,	July 15	4	4	Do. 4 p.c. Deb. ...	100—102	...	...
165,736	,,	Sept. 5	10	8	Maidstone 5 p.c. Cap. ...	160—170	...	...
56,176	,,	June 20	3	3	Do. 3 p.c. Deb. ...	69—74	...	...
75,000	5	June 20	†10	†10	Malta & Mediterranean ...	7½—8½	...	...
892,000	—	Oct. 1	5½	5½	Metropolitan (of Melbourne) 5½ p.c. Red. Deb. ...	97—102	...	...
171,978	Stk.	Sept. 5	5	5	M. S. Utility "C." Cons. ..	100—110	...	104½—105
718,657	,,	,,	4	4	Do. 4 p.c. Cons. Pref.	90—95	...	90½—91½
112,126	,,	July 4	4	4	Do. 4 p.c. Deb. ...	95—100	...	...
148,955	,,	,,	5	5	Do. 5 p.c. Deb. ...	115—120	...	...
675,000	,,	21 May '31	16	16	Montevideo, Ltd.	35—45	...	34—39
2,061,316	,,	Aug. 8	5½	5	Newcastle & Gateshead Con.	22.3—23.3[d]	...	...
682,856	,,	,,	4	4	Do. 4 p.c. Pref. ...	91—93[d]	+1	...
691,705	,,	June 20	3½	3½	Do. 3½ p.c. Deb. ...	89—91[d]	...	...
277,285	,,	Nov. 7	5	5	Do. 5 p.c. Deb. '43...	103—107[d]	...	...
274,000	,,	Aug. 8	5	5	Newport (Mon.) 5 p.c. max.	93—95[c]	...	...
199,940	,,	Aug. 22	7½	7½	North Middlesex 6 p.c. Con.	135—145	...	141½—143
396,160	,,	Aug. 8	5	5	Northampton 5 p.c. max. ...	96—101	...	...
300,000	,,	Apl. 18	9	7	Oriental, Ltd.	106—111	...	109—110
205,162	,,	June 20	8	8	Plym'th & Stonehouse 5 p.c.	148—153	+1	143½
504,416	,,	Aug. 22	8	8	Portsm'th Con. Stk. 4 p.c. Std.	150—160	+3	152½—158½
241,446	,,	,,	5	5	Do. 5 p.c. max. ...	97—102	...	100
114,000	,,	Aug. 8	5	5	Preston 5 p.c. Pref. ...	105—110	...	...
686,312	,,	July 18	4	4	Primitiva 4 p.c. Rd. Db. 1911	77—82	...	...
389,813	,,	June 20	4	4	Do. 4 p.c. Cons. Deb.	77—82	...	...
150,000	10	Sept. 19	6	6	San Paulo 6 p.c. Pref. ...	6¾—7¼	...	...
1,736,968	Stk.	Sept. 5	6	6	Sheffield Cons.	110—114[e]	...	...
95,000	,,	July 18	4	4	Do. 4 p.c. Deb.	92—96[e]	...	...
133,201	,,	Sept. 5	8	8½	Shrewsbury 5 p.c. Ord. ...	113—118	...	...
90,000	10	June 6	15	15	South African	4—6	...	...
6,709,895	Stk.	Aug. 8	7	5	South Met. Ord.	120—125	...	121—123
1,135,812	,,	,,	6	6	Do. 6 p.c. Irred. Pf.	138—143	−2	139—141½
1,895,445	,,	July 4	3	3	Do. 3 p.c. Deb.	80—83	...	81
1,000,000	,,	July 18	4	5	Do. 5 p.c. Red. Deb.	109—114	...	112
91,500	,,	Aug. 8	8½	8½	South Shields Con.	140—145[d]	...	...
1,543,795	,,	Aug. 8	6	6	South Suburban Ord. 5 p.c.	118—123	+1	...
300,000	,,	,,	5	5	Do. 5 p.c. Pref.	113—118	...	114½—117
668,837	,,	June 20	5	5	Do. 5 p.c. Deb.	120—125	...	120—121
647,740	,,	Aug. 22	5	5	Southampt'n Ord. 5 p.c. max.	101—106	...	...
121,275	,,	June 20	4	4	Do. 4 p.c. Deb.	95—100	...	...
350,000	,,	Aug. 8	—	9/-	Swansea 5½ p.c. Red. Pref.	110—114	...	...
200,000	,,	June 20	6½	6½	Do. 6½ p.c. Red. Deb.	105—110	...	...
1,076,490	,,	Aug. 8	6¾	6¾	Tottenham and District Ord.	131—136	...	133—135
300,000	,,	,,	5½	5½	Do. 5½ p.c. Pref. ...	120—125	...	...
199,005	,,	June 20	4	4	Do. 4 p.c. Deb. ...	95—100	...	98
85,701	,,	Sept. 19	6	6	Tuscan, Ltd., 6 p.c. Red. Db.	67—72	...	...
346,069	,,	Aug. 22	7	7	Uxbridge, &c., 5 p.c. ...	130—140	...	...
88,330	,,	,,	5	5	Do. 5 p.c. Pref. ...	112—117	...	...
1,322,220	,,	July 4	7	7	Wandsworth Consolidated	136—141	+1	139½—141
1,036,373	,,	,,	5	5	Do. 5 p.c. Pref.	115—120	...	116
1,317,964	,,	June 20	5	5	Do. 5 p.c. Deb.	120—125	...	121½
158,400	,,	Aug. 22	5g	5	Winchester W. & G. 5p.c. Con.	100—105	...	...

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£30,000

OF CONSOLIDATED ORDINARY (NEW) STOCK

of the Gloucester Gas Light Company, bearing Interest at 5 per cent. per annum.

Further Particulars and Conditions of Sale may be had from Mr. T. B. JAMES, Secretary, GAS OFFICES; Messrs. TAYNTON & SON, Solicitors, CLARENCE CHAMBERS; or of the AUCTIONEER, ALBION CHAMBERS, GLOUCESTER.

By Order of the Directors.

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Messrs. A. & W. RICHARDS

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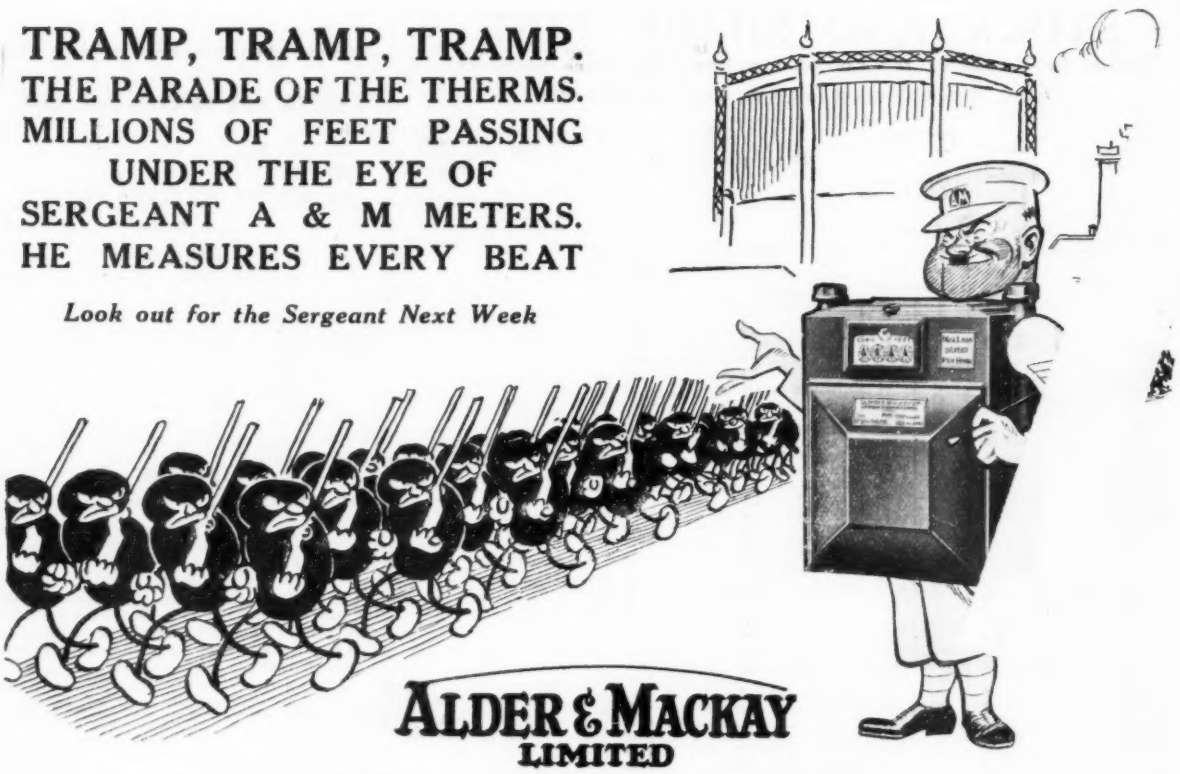

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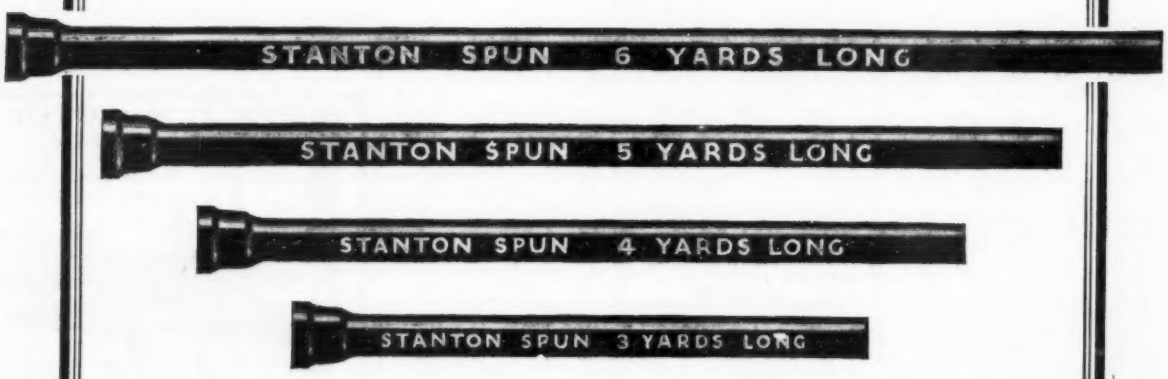

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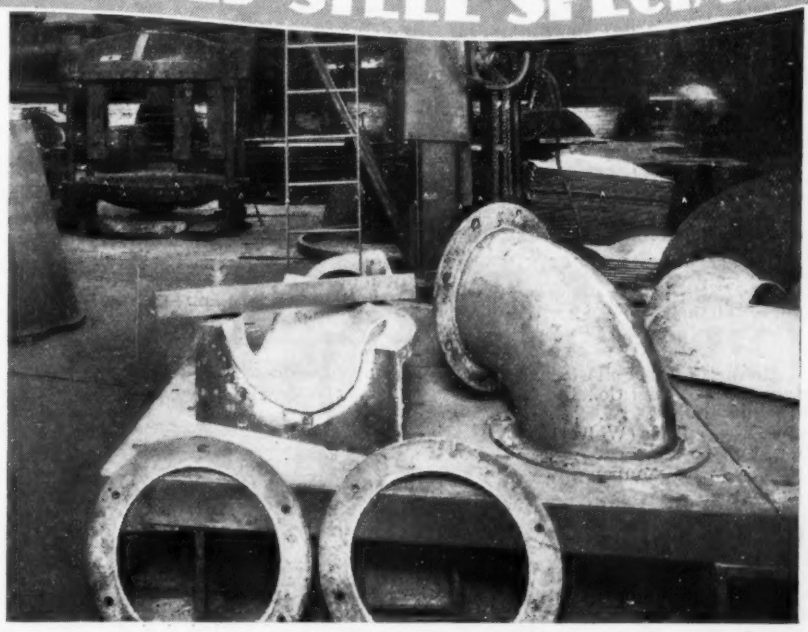

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